AD NUMBER
ADB385849
LIMITATION CHANGES
TO: **Approved for public release; distribution is unlimited.**
FROM: **Distribution authorized to DoD and DoD contractors only; Administrative/Operational Use; JUN 2012. Other requests shall be referred to Naval Air Systems Command, Attn: Code 4.3.1, 48110 Shaw Rd., Patuxent River, MD 20670-1906.**
AUTHORITY
NAWCADPAX errata dtd 2 Jul 2013

UNCLASSIFIED

NAVAL AIR WARFARE CENTER AIRCRAFT DIVISION
PATUXENT RIVER, MARYLAND

TECHNICAL REPORT

REPORT NO: NAWCADPAX/TR-2012/219

THIRD PARTY RISK ASSESSMENT TOOL (3PRAT) USER GUIDE

by

Michael Knott
Davy Andrew
Dr. David Burke
Roland Cochran

26 June 2012

UNCLASSIFIED

DEPARTMENT OF THE NAVY
NAVAL AIR WARFARE CENTER AIRCRAFT DIVISION
PATUXENT RIVER, MARYLAND

NAWCADPAX/TR-2012/219
26 June 2012

THIRD PARTY RISK ASSESSMENT TOOL (3PRAT) USER GUIDE

by

Michael Knott
Davy Andrew
Dr. David Burke
Roland Cochran

RELEASED BY:

26 Jun 2012
ROLAND COCHRAN / AIR-4.3.1 / DATE
Systems Engineering Division
Naval Air Warfare Center Aircraft Division

REPORT DOCUMENTATION PAGE				Form Approved OMB No. 0704-0188

1. REPORT DATE 26 June 2012	2. REPORT TYPE Technical Report	3. DATES COVERED May 2011 - June 2012

4. TITLE AND SUBTITLE Third Party Risk Assessment Tool (3PRAT) User Guide	5a. CONTRACT NUMBER 5b. GRANT NUMBER 5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S) Michael Knott Andrew Davy Dr. David Burke Roland Cochran	5d. PROJECT NUMBER 5e. TASK NUMBER 5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Air Warfare Center Aircraft Division 48110 Shaw Road Patuxent River, Maryland 20670-1906	8. PERFORMING ORGANIZATION REPORT NUMBER NAWCADPAX/TR-2012/219
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) OUSD(AT&L)/S&TS-Unmanned Warfare Room # 3B938 3090 Defense Pentagon Washington, DC 20301-3090	10. SPONSOR/MONITOR'S ACRONYM(S) 11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT

Distribution authorized to DOD and U.S. DOD contractors only; Administrative or Operational Use; June 2012. Other requests shall be referred to the Naval Air Systems Command (Code 4.3.1), 48110 Shaw Road, Patuxent River, Maryland 20670-1906.

13. SUPPLEMENTARY NOTES

14. ABSTRACT

The purpose of this User Guide is to provide a step-by-step tutorial for using the Third Party Risk Assessment Tool (3PRAT). The User Guide provides written instruction steps, a visual depiction of the step, and examples of how to manipulate the tool. 3PRAT is a Matlab developed software which contains a graphical user interface to simplify the user's experience. The 3PRAT provides calculations of risk based on user input, it is critical that the user understand the assumptions, limitations, and basis for the values input into the tool.

15. SUBJECT TERMS

Third Party Risk Assessment Tool (3PRAT); User Guide

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON Dr. David Burke
a. REPORT	b. ABSTRACT	c. THIS PAGE			19b. TELEPHONE NUMBER (include area code)
Unclassified	Unclassified	Unclassified	SAR	55	(301) 342-2185

SUMMARY

This User Guide provides a step-by-step tutorial for using the Third Party Risk Assessment Tool (3PRAT). The User Guide provides written instruction steps, a visual depiction of the step, and examples of how to manipulate the tool. This document provides step-by-step introduction into the necessary inputs and expected outputs from 3PRAT. A hypothetical Unmanned Air Systems example, the fixed wing “Robin” is provided to assist in the comprehension of the lethal crash area portion of the tool. Specifications for the Robin are available in the Appendix. The 3PRAT provides calculations of risk based on user input, it is critical that the user understand the assumptions, limitations, and basis for the values input into the tool.

Contents

Page No.

Page No.

INTRODUCTION

Expanding the permitted airspace permissions for Unmanned Air Systems (UAS) is a common desire among multiple military and civilian government organizations. Military groups desire to expand the UAS airspace to improve reserve and operational logistics, training exercises, and testing purposes. Civilian agencies, such as police forces, border patrol, and news agencies would use unmanned aerial vehicles (UAVs) to conduct aerial surveillance and other missions strongly suited to the UAS. Current air space restrictions limit flight to either restricted airspace or areas with sparse populations. While lifting these restrictions would have a positive impact on operational envelope and flexibility, due diligence must be used to ensure the public is not subjected to unreasonable hazards.

One of the critical requirements for expanding the operational area of UAS is to understand the risk to uninvolved third parties on the ground posed by the crash of a UAS. In order to address this issue, Office of Secretary of Defense, Strategic and Tactical Systems – Unmanned Warfare office has sponsored the Target Level of Safety (TLS) to Third Parties program. The objective of this program is to define a consistent calculation method to determine the relationship between UAS reliability, potential to cause damage and where it flies. NAVAIR (AIR-4.3.1) has led the effort to develop this methodology. The TLS Program includes five modules; Casualty Expectation, Probability of Loss of Aircraft (PLoA), Potential Crash Location, Lethal Crash Area (LCA), and Population Density. These modules are integrated together into the Third Party Risk Assessment Tool (3PRAT).

The purpose of this tool is to provide the user with the casualty expectation from an UAS given certain details and assumptions of components and component failures, phase of flight, and aircraft characteristics.

This document provides step-by-step introduction into the necessary inputs and expected outputs from 3PRAT. A hypothetical UAS example, the fixed wing “Robin” is provided to assist in the comprehension of the LCA portion of the tool. Specifications for the Robin are available in the Appendix.

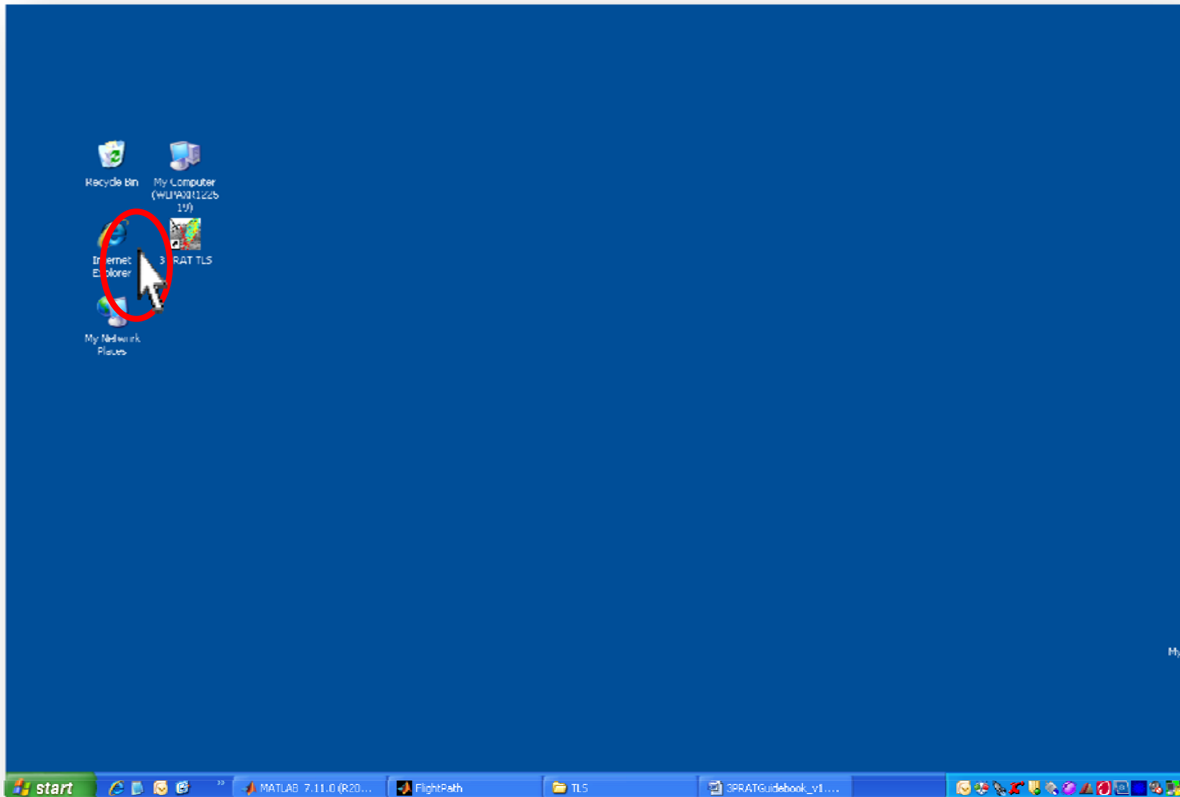
USER GUIDE

The purpose of this User Guide is to provide a step-by-step tutorial with using the 3PRAT. The User Guide provides written instruction steps, a visual depiction of the step, and examples of how to manipulate the tool.

3PRAT is a Matlab-developed software which contains a graphical user interface (GUI) to simplify the user’s experience. Some of the mathematical calculation requires the software to references an Excel based spreadsheet. The spreadsheet contains some of the initial mathematical formulas derived by the authors and is mainly used to determine the footprint size and LCA of UAS. Although Excel is referenced it is to be noted that the user will not need to interact with Excel to use this tool.

GETTING STARTED

The 3PRAT can be opened in any folder that the base operating system has access to. If using a share drive folder please ensure you have read/write privileges or contact an administrator. In this example, the tool is located on the desktop to allow ease of access for the user.

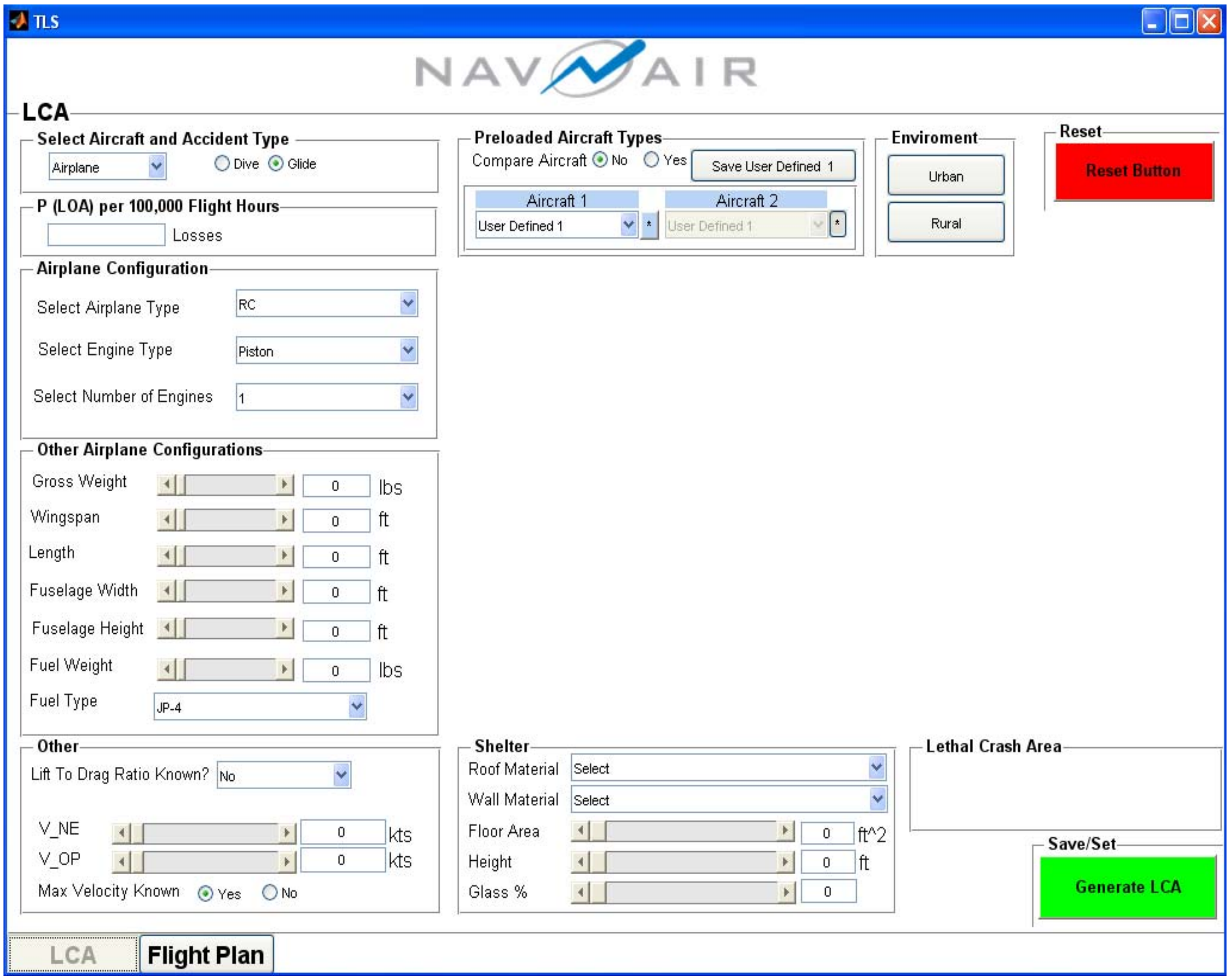


Move the cursor over the icon.

Alternatively, the file may be opened from a folder directory. Simply open the folder or directory that the 3PRAT file is located and double click the file, or highlight it with the mouse and press Enter.

LETHAL CRASH AREA – LCA TAB

The Lethal Crash Area or LCA Tab is the home screen of the 3PRATl. It is where the user will input the majority of data relating to the characteristics of the aircraft.



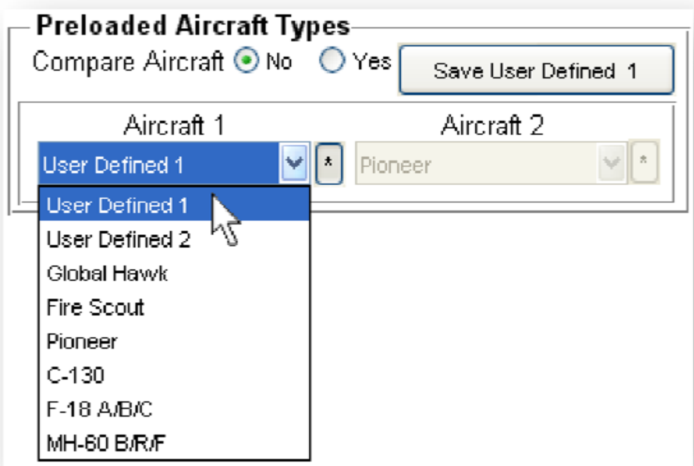
In the LCA section, you will be asked to first select options pertaining to the aircraft type and configuration. This gives the 3PRAT knowledge of what type of similar vehicles to draw from its database to analyze your UAS. You will then enter physical parameters of the aircraft including weight, dimensions, fuel type, and some performance information. Finally, the anticipated shelter information should be altered. When all information is entered and the Generate LCA button is clicked, the LCA Panel will output a numerical value for the entire LCA in square feet.

The RESET button is provided to the user to reset or clear all previous inputs. This provides the user with a clean slate with which to input a new aircraft model.

INPUTS

The 3PRAT allows users the option to either manually enter each aircraft parameter or to choose from a list of aircraft containing already predefined parameters.

To manually input aircraft parameters, first navigate to the [Preloaded Aircraft Type] panel, and select either User Defined 1 or User Defined 2 as seen below. (By selecting one of these options the user is specifying *as to which user defined profile will store the manually entered data*) Clicking the Save User Defined # button will store A/C parameter as long as the program is not restarted



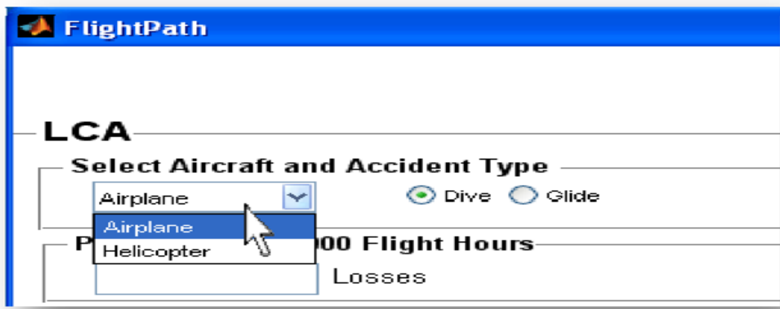
After User Defined 1 or 2 is selected, the user can then manually specify the following aircraft parameters:

<u>Accident Type</u>

To choose the accident type to investigate, navigate to the [Select Aircraft and Accident Type] panel and select the appropriate radial button as shown below. The options available are Dive or Glide.

Aircraft Type

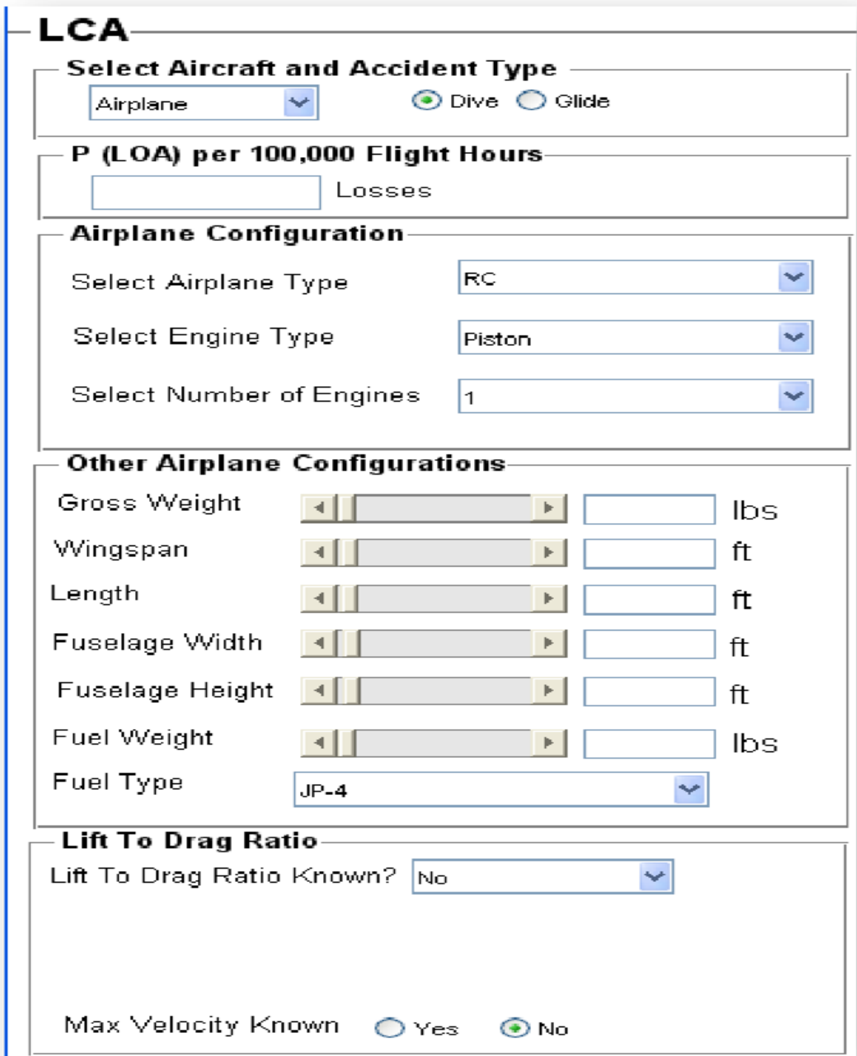
To choose the Aircraft Type, navigate to the [Aircraft and Accident Type] panel, click on the drop down menu and select the aircraft type. There are currently two options available for UAS: Airplane and Helicopter. Simply click on the arrow to the right and select the aircraft type that corresponds to your air vehicle.



When the aircraft type is selected, additional options will appear depending on whether Airplane or Helicopter is chosen. At program start up Airplane is selected as a default, this creates additional panels pertaining to Aircraft parameters that can be configured. Selection of Helicopter as an Aircraft type will yield new parameters options that will appear on the right of the LCA page.

Airplane

The following are input options available only after the Aircraft Type selection has been made to Airplane.



Probability Loss of Aircraft

To specify the PLoA, navigate to the P (LOA) per 100,000 Flight-Hours panel. The user must enter loss of aircraft information on the aircraft being investigated in this panel. (T*he PLoA of crashes/mishaps that occurred based on historical data of 100,000 flight hours for the legacy F-18 can be seen below.)*

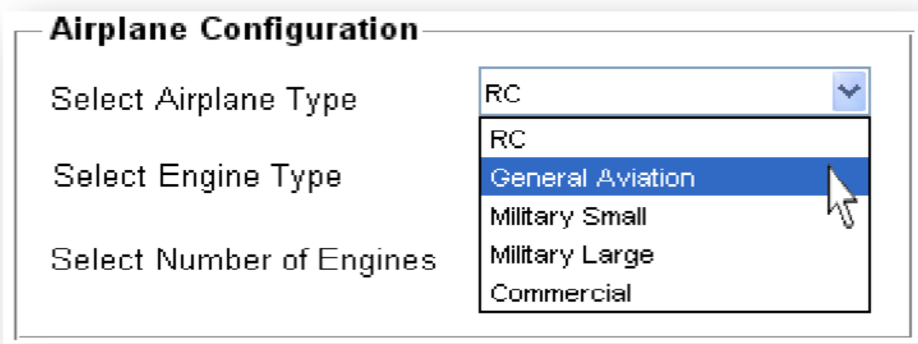
Airplane Type

The Airplane Type indicates the air vehicle that most closely represents the aircraft that is being evaluated. The choices are RC, General Aviation, Military Small, Military Large, and Commercial.

To choose the airplane type, navigate to the [Airplane Configuration] panel, click on the drop down menu and select airplane type.

The fictional UAS Robin will serve as an example for how to input aircraft characteristics into 3PRAT.

Example: Robin UAS



Robin UAS would be considered a General Aviation aircraft and the picture above shows the General Aviation case beina selected.

The following descriptions can assist you in the appropriate selection of Airplane Type:

General Aviation

When in doubt, the General Aviation selection should provide a reasonable amount of accuracy for the UAS being evaluated. The General Aviation case is best represented for fixed wing UAS that have some means of propeller driven thrust. That is both turboprops and reciprocating propeller driven aircraft should be considered to fall under this category.

Remote Controlled

For aircraft <100 lb, it is suggested that the Remote Controlled (RC) option be chosen. 3PRAT will alter results to reflect the aircraft crash mechanisms that are similar to a home-built/operated Remote Controlled or RC plane.

Military Small

Military Small aircraft is selected if the UAS can be considered a “performance” aircraft. Due to speed and maneuverability requirements, this should only be selected if the aircraft is expected to perform mid to high g maneuvers and operate within or above the transonic flight regime. Examples of manned aircraft that fit this category are fighters, attack aircraft, high speed bombers, and their corresponding trainer aircraft.

Military Large

Military Large aircraft should be selected for UAS that have either turbo jet or turbo fan engines, do not conform to the Military Small aircraft requirements in terms of performance, and have wingspans greater than 50 ft. Examples of manned aircraft that fit this category include cargo, executive transport, and aerial refueling platforms.

Commercial

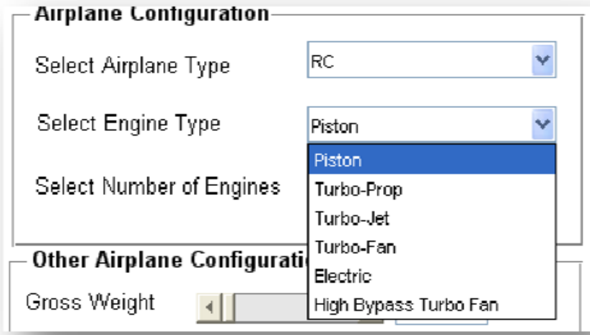
Commercial aircraft reflect aircraft are of the same size, performance, and mission capability similar to modern commercially operated passenger aircraft (e.g., B737, A330, DC10 etc.). Currently, there is no known operational UAS that operates in this category; however, it is included as a hypothetical case for possible future conversation. This option should only be selected for UAS that operate with two or more turbo fan engines, a wingspan greater that 75 ft, and gross weights above 20,000 lb.

Engine Type

The Engine Type depicts the type of propulsion the UAS is configured with. If your UAS exhibits some kind of new propulsion system select either the reciprocating or the electric drive train depending on whether your system requires air combustion or not.

To choose engine type, navigate to the [Airplane Configuration] panel, click on the drop down menu and select the appropriate engine type.

Robin UAS Cont'd



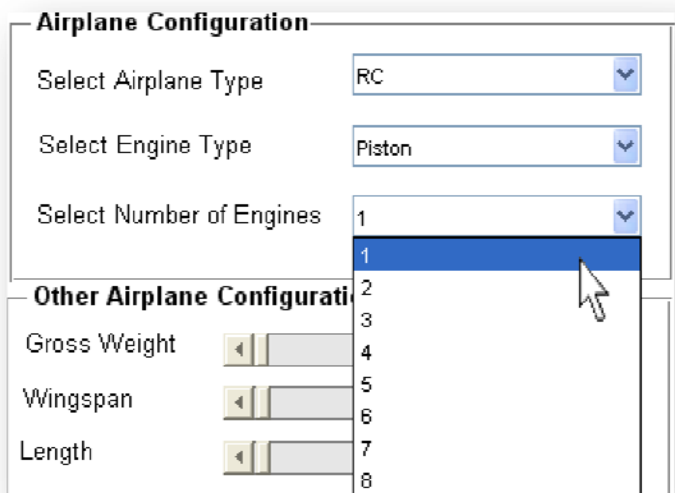
The Robin is assumed to use a piston engine to drive a propeller to generate thrust. Therefore, the user would select Piston as shown.

Select Number of Engines

While most UAS operate with a single engine to maximize weight efficiencies and reduce costs, it is conceivable that future UAS could operate with multiple engines.

To specify number of engines, navigate to the [Airplane Configuration] panel, click the drop down menu and select the number of engines.

Robin UAS Cont'd



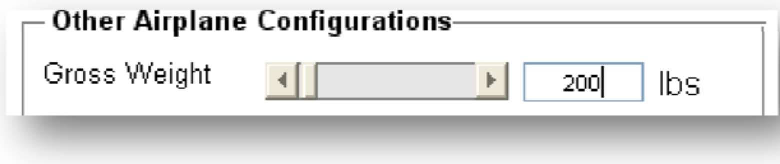
The Robin, however, is a more conventional UAS with a single piston engine.

Gross Weight

The Gross Weight (GW), also known as the Maximum Takeoff Weight, is the maximum weight that the aircraft can takeoff when fully fueled and with maximum payload.

To input the GW, navigate to the [Other Airplane Configurations] panel and input the weight of the aircraft in pounds. This can be done by either adjusting the scroll bar or by inputting the information directly into the associated field.

Robin UAS Cont'd



Shown above is GW of the Robin, 200 lbs, being entered manually into the corresponding input box.

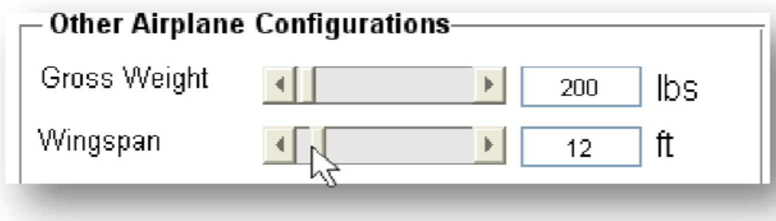
Note: If values are entered directly, the scroll bar position will not reflect the change.
Final values that are entered and appear within the input box will be used for calculation.

Wingspan

The wingspan is the distance from one wingtip to the other in feet.

To input the Wingspan length of the aircraft, navigate to the [Other Airplane Configurations] panel and input the wingspan in feet for your aircraft. This can be done either by adjusting the scroll bar or by entering the information directly into the associated field.

Robin UAS Cont'd



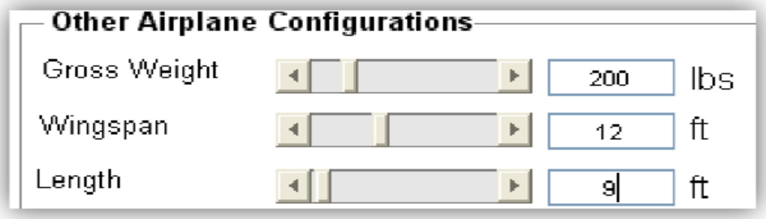
Shown being entered in through the scroll bar above is the wingspan of the Robin which is 12 ft.

Length

The length is the distance from the forward most feature on the aircraft's centerline (typically the nose) to the furthest backward feature, typically the tail or an element of the propulsion.

To input the length of the aircraft, navigate to the [Other Airplane Configurations] panel and input the length in feet. This can be done either by adjusting the scroll bar or by entering the information directly into the associated field.

Robin UAS Cont'd



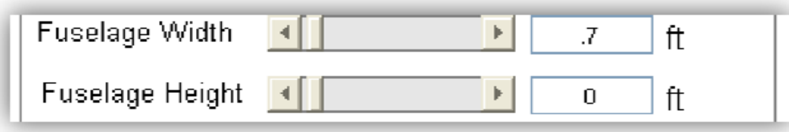
Above you can see the Robin length of 9 ft being entered into the corresponding field.

Fuselage Width

The fuselage is the main body section of the aircraft that typically holds passengers, avionics, payloads, and fuel. In a UAS, this section may be used for mission systems, avionics, and payloads. Enter the width of the fuselage in feet directly into the associated field.

To input the fuselage width of the aircraft, navigate to the [Other Airplane Configurations] panel and input the width in feet. This can be done either by adjusting the scroll bar or by entering the information directly into the associated field.

Robin UAS Cont'd



Robin's width of 0.7 ft is shown being implemented in the appropriate field. Note: For blended wing or flying wing concepts such as the aircraft shown below, use a width of 1/3 the wingspan.

Fuselage Height

The height of the fuselage is the height from the bottom to top of the fuselage and should NOT include landing gear or any other dimension associated with ground height.

To input the fuselage height of the aircraft, navigate to the [Other Airplane Configurations] panel and input the height in feet. This can be done either by adjusting the scroll bar or by entering the information directly into the associated field.

Robin UAS Cont'd

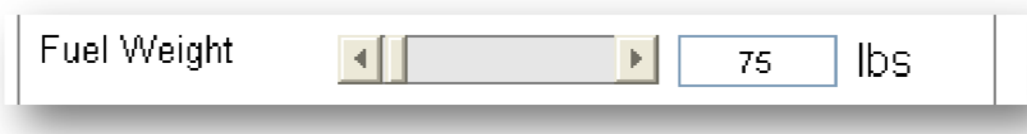
Robin's width of 0.7 ft is shown being implemented in the appropriate field. Note: For blended wing or flying wing concepts such as the aircraft shown below, use a width of 1/3 the wingspan.

Fuel Weight

The amount of fuel will have an impact on the expected result of fireballs, explosions, and secondary fires. If the fuel used on the aircraft is not combustible, use the weight of the battery or fuel cell being used.

To input the fuel weight, navigate to the [Other Airplane Configurations] panel and input the weight in pounds. This can be done either by adjusting the scroll bar or by entering the information directly into the associated field.

Robin UAS Cont'd



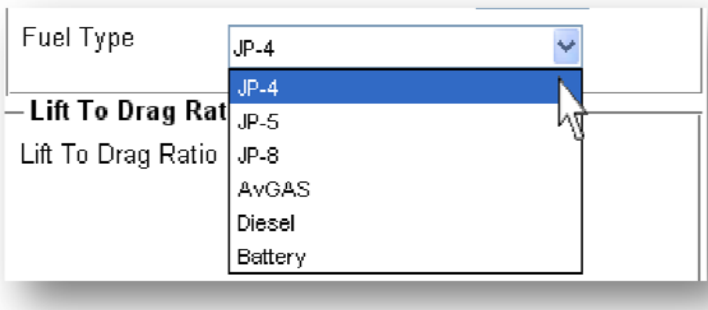
Robin fuel weight is 75 lb.

Fuel Type

Similar to the amount of fuel, the fuel type is another important variable when considering secondary hazards to personnel. For aircraft operating on "regular" gasoline such as Octane 87, AvGas should be selected.

To specify fuel type, navigate to the [Other Airplane Configurations] panel, click the drop down menu and select the appropriate fuel type.

Robin UAS Cont'd



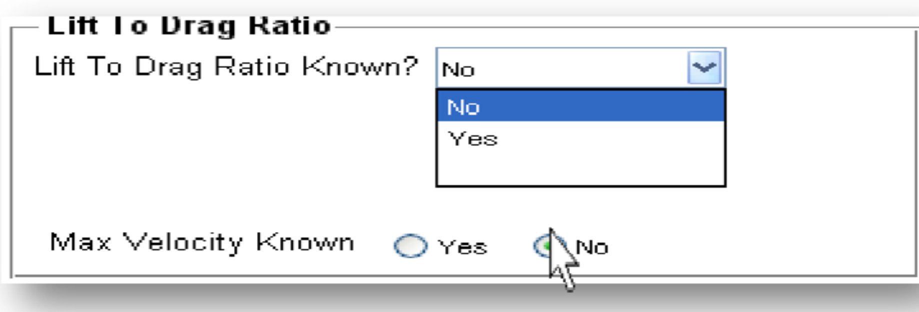
The Robin is assumed to use 87 or higher octane gasoline. For this case, the selection of AvGas will result in approximately the same characteristics.

Lift to Drag Maximum

The Maximum Lift to Drag (L/D) ratio is reflective of the aerodynamic performance of the aircraft. It is a parameter relating to the glide performance of an airplane.

To specify the max lift to drag ratio, navigate to the [Lift to Drag Ratio] panel, click the drop down menu and select the appropriate choice. L/D max is defaulted to No and if not changed the 3PRAT will auto generate an approximate L/D based on aircraft wingspan. The wingspan can even be adjusted and the L/D will be recalculated to account for the change.

Robin UAS Cont'd



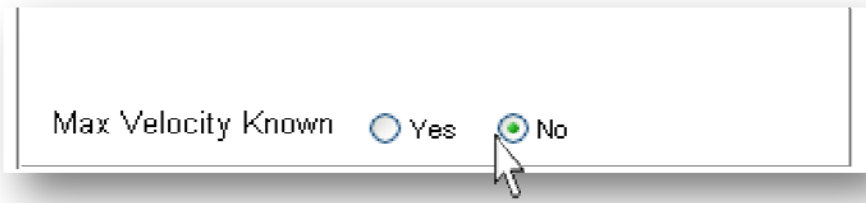
In the example of the Robin UAS, it is assumed that L/D max is not known. The appropriate choice is selected and 3PRAT auto populates an L/D max value as shown in the picture above.

Maximum Velocity

The maximum velocity is the velocity limit at which the aircraft can sustain continued flight. Beyond this velocity, factors such as loads, vibration, and flutter will begin to break the aircraft apart. This is sometimes referred to as the Never Exceed Velocity or Vne.

To specify max velocity, navigate to the [Lift to Drag] panel and select the appropriate radial button as shown below.

Robin UAS Cont'd



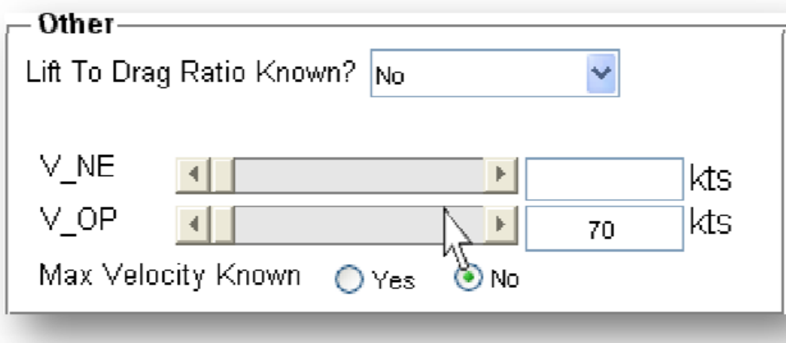
For this example, it will be assumed that the Robin UAS did not come with a specification for max speed. Therefore in the picture above, the cursor is choosing the option no. Instead of a max velocity, an operating velocity will be used.

Operating Velocity

The operating velocity is the velocity that the aircraft was designed to fly at for the duration of nonmaneuvering flight. For surveillance UAS this would be the max endurance, or loiter, velocity while for a transport aircraft it would most likely be max range or cruise velocity.

To specify operating velocity, navigate to the [Lift to Drag] panel, and ensure that the lift to drag ratio know is set to yes. The Operating Velocity (V_OP) then can be chosen either by manipulating the slider bar or entering the information directly.

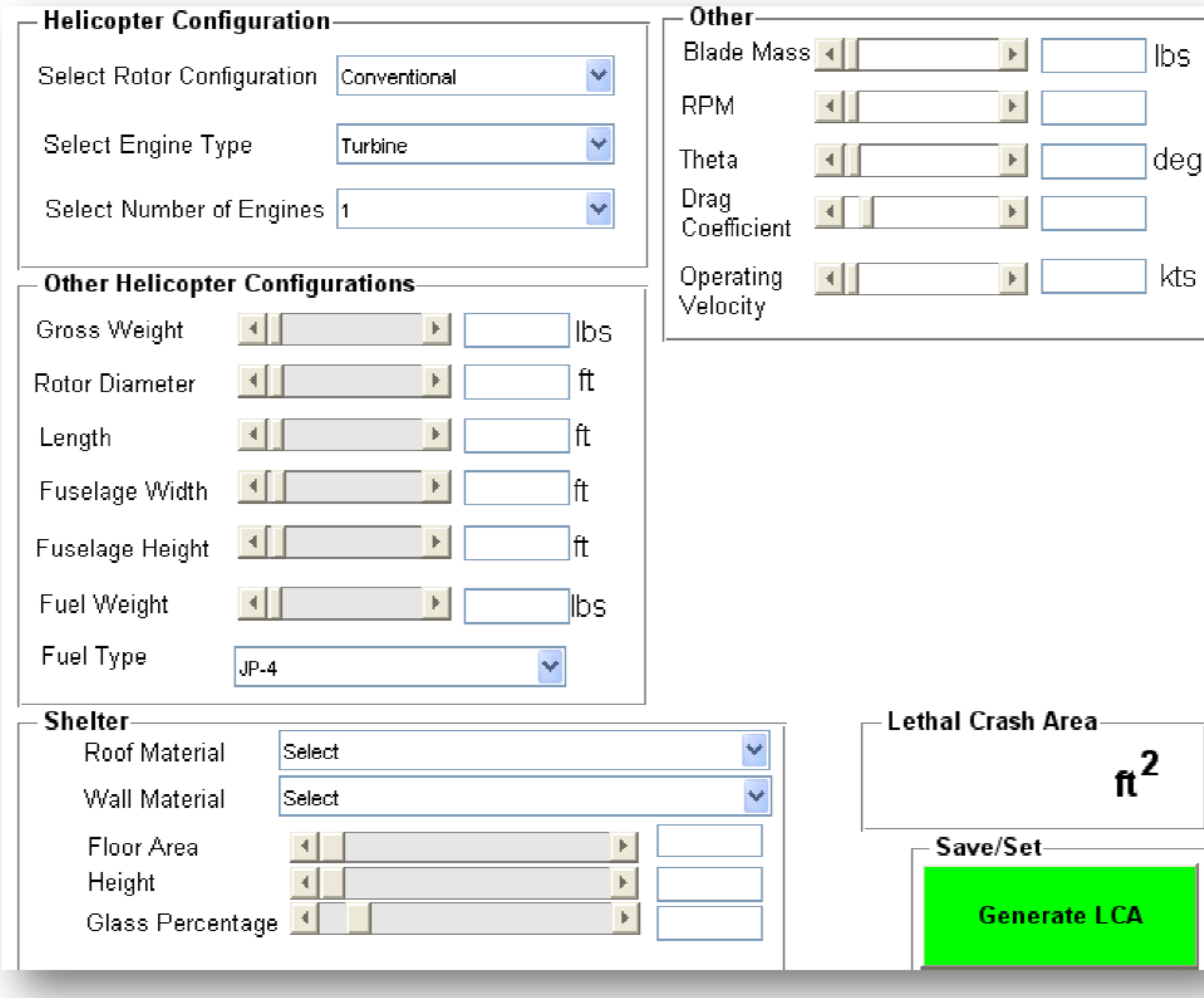
Robin UAS Cont'd



For the Robin case, both the maximum and operating velocity are unknown. The operating velocity can be entered by manipulating the scrollbar as shown above for the Robin's operational velocity of 70 kt.

Helicopter

The following are input options available only after the Aircraft Type selection has been made for Helicopter. Input values according to each individual section. While the helicopter inputs will share some common items with the airplane, there are several unique items that the user may not be familiar with.



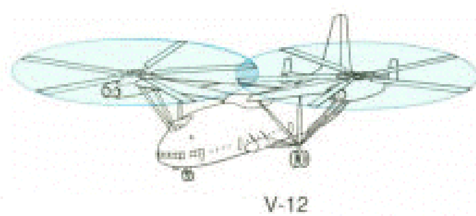
Rotor Configuration

The rotor configuration describes how the main rotor(s) are attached to the aircraft and the mechanism for countering the torque of the main rotor.

To specify the rotor configuration, navigate to the [Helicopter Configuration] panel, click the drop down menu and select the appropriate rotor choice. Descriptions of these choices are explained below.

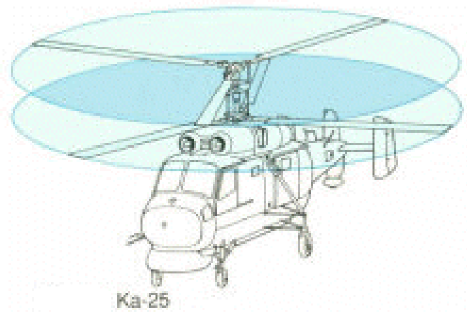
Conventional: In a conventional helicopter, there is a single main rotor and a smaller tail rotor to oppose the torque being exerted by the engines on the main rotor. When most individuals think of a helicopter, this is the image they see. Similar helicopters include the H-60 Blackhawk, the AH-64 Apache, and Bell 204.

Tandem: A tandem helicopter system has two rotor blades set apart from one another rotating in opposite directions. The two blades result in a much greater lifting surface to allow the helicopter to lift large amounts of payload. They may be either one in front of the other such as in the H-47 Chinook or H-46 Frogbat, or side by side such as the largest helicopter ever built, the Russian MIL MI-12. The counter rotating blades also counteract the torque of each other eliminating the need for a tail rotor. Downsides of this configuration are the higher complexity and weight required to drive the twin main rotors and is therefore usually only relegated to larger helicopters.



Intermeshing: Intermeshing helicopters have two rotors separated from each other similar to the tandem configuration rotating in opposite directions to counter torque. The difference is that the blades are tilted such that the blades intermesh with one another. This method can provide strong lift characteristics for a relatively smaller helicopter but requires a more complex transmission. Examples of this helicopter include the Kaman Kmax or the older Kaman HH-43.

Coaxial: In a coaxial helicopter, there are again two blades rotating in opposite directions to counteract each other's torque. What is unique about this configuration is that they are placed one on top of the other. Coaxial helicopters benefit from having smaller equivalent rotor diameters for the same lift performance of conventional rotors, but have increased weight for the combined drive train. Examples of coaxial rotors include the new X-2 high-speed concept helicopter and the Russian Kamov Ka-25 used extensively for Soviet/Russian maritime purposes.



Engine Type

The Engine Type reflects the type of primary mechanism for driving the main rotors. These can be piston internal combustion engines, turbines, or electric motors.

To specify the engine type, navigate to the [Helicopter Configuration] panel, click the drop down menu and select the appropriate engine type.

Number of Engines

The number of engines reflects the total number of engines used on the air vehicle. Select the number on the UAS in question by selecting the arrow and again making the choice with the drop down menu.

To specify the number of engines, navigate to the [Helicopter Configuration] panel, click the drop down menu and select the number of engines.

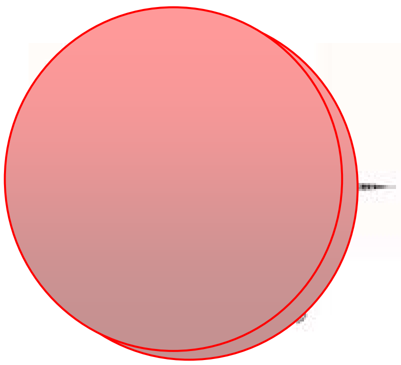
Gross Weight

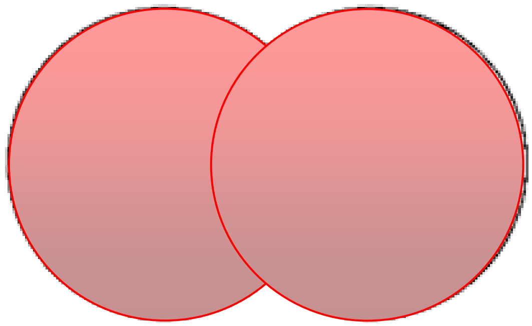
The GW, also known as the Maximum Takeoff Weight, is the maximum weight that the aircraft can takeoff when fully fueled and with maximum payload.

To input the GW, navigate to the [Other Helicopter Configurations] panel and input the aircraft GW in pounds. This can be done either by adjusting the scroll bar or by entering the information directly into the associated field.

Rotor Diameter

The Rotor Diameter is the diameter of the main rotor for conventional and coaxial helicopters. For conventional and coaxial UAS helicopters simply enter the rotor diameter with either the scrollbar or enter the information directly into the appropriate field. For helicopters other than conventions (Tandem and Intermeshing), a text box will appear.





On the left is the case of intermeshing rotors. Note that there is only a small area that needs to be added to that of a single rotor. For the case of the tandem helicopter on the right, there is much more area that needs to be considered. Note: do not double-up areas where rotor areas are on top of one another.

Length

The length of the helicopter is the length from the forward most point of the fuselage, NOT the main rotors, to the end of the tail.

To input the length of the aircraft, navigate to the [Other Helicopter Configurations] panel and input the length in feet. This can be done either by adjusting the scroll bar or by entering the information directly into the associated field.

Fuselage Width

The fuselage width is the width of the main fuselage. Do NOT count the added width from items such as external fuel tanks or “wings” used for payload storage.

To input the fuselage width of the aircraft, navigate to the [Other Helicopter Configurations] panel and input the width in feet. This can be done either by adjusting the scroll bar or by entering the information directly into the associated field.

Fuselage Height

The height of the fuselage is the height from the bottom to top of the fuselage and should NOT include landing gear or any other dimension associated with ground height.

To input the fuselage length of the aircraft, navigate to the [Other helicopter Configurations] panel and input the height in feet. This can be done either by adjusting the scroll bar or by entering the information directly into the associated field.

Fuel Weight

The amount of fuel will have an impact on the expected result of fireballs, explosions, and secondary fires. If the fuel used on the aircraft is not combustible, use the weight of the battery or fuel cell being used.

To input the fuel weight of the aircraft, navigate to the [Other Helicopter Configurations] panel and input the weight in pounds. This can be done either by adjusting the scroll bar or by entering the information directly into the associated field.

Fuel Type

Similar to the amount of fuel, the fuel type is another important variable when considering secondary hazards to personnel. For aircraft operating on "regular" gasoline such as Octane 87, select AvGas, or if the aircraft is electrically powered select battery.

To specify fuel type, navigate to the [Other Airplane Configurations] panel, click the drop down menu and select the appropriate fuel type.

Operating Velocity

The operating velocity is the velocity that the aircraft was designed to fly at for the duration of nonmaneuvering flight. For surveillance UAS, this would be the max endurance, or loiter, velocity while for a transport aircraft it would most likely be max range or cruise velocity.

To input the operating velocity of the aircraft, navigate to the [Other] panel and input velocity in knots. This can be done either by adjusting the scroll bar or by entering the information directly into the associated field.

<u>Blade Mass</u>

The blade mass indicates the mass of a single rotor.

To input the blade mass of the aircraft's rotor, navigate to the [Other] panel and input blade mass in pounds. This can be done either by adjusting the scroll bar or by entering the information directly into the associated field.

Rotations per Minute

The Rotations per Minute (RPM) measures the speed at which the rotor blades turn. This information is pertinent particularly to the risk of blade failure/fragmentation.

To input the rpm, navigate to the [Other] panel and input rpm value. This can be done either by adjusting the scroll bar or by entering the information directly into the associated field.

Theta

Theta is the angle of which a blade or blade fragment would be thrown above the horizon should an accident occur. Enter a value representative of the anticipated failure mode of the helicopter. This user guide suggests that the value of 10 and 30 deg be used to give the user some idea of the range of blade related hazard area.

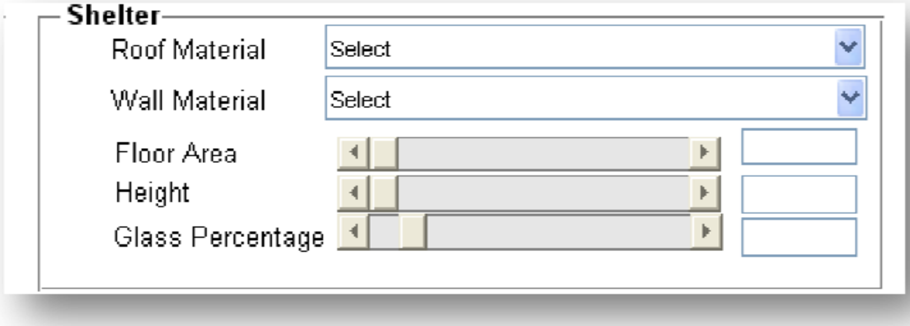
To input the theta value, navigate to the [Other] panel and input the value. This can be done either by adjusting the scroll bar or by entering the information directly into the associated field.

Blade Drag Coefficient

The blade drag coefficient represents the amount of wind resistance a failed or fragmented rotor blade would encounter after being thrown from the helicopter. Entering a value of 0 results in projectile motion with no drag effects. This user guide suggests a drag coefficient of 0.05 for a realistic assessment of a helicopter rotor blade.

To input the blade drag coefficient, navigate to the [Other] panel and input the value. This can be done either by adjusting the scroll bar or by entering the information directly into the associated field, values between 0 and 1.

Shelter

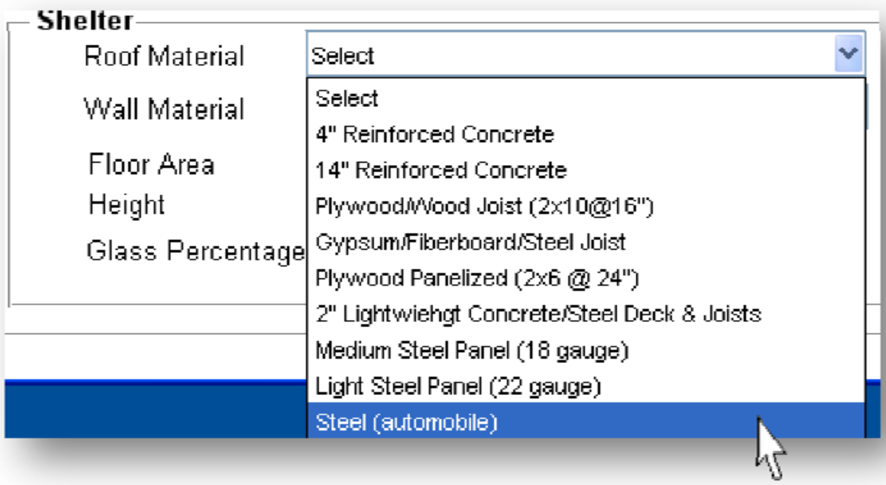


The 3PRAT takes into account the added affects of shelter to determine the lethal crash area. Sheltering affects can reduce the susceptibility of persons to aircraft crashes. Enter shelter most representative of the area that is likely to be impacted. When in doubt, there are two pushbutton shortcuts provided at the top of the screen: Rural and Urban.

The Rural option will select all the following parameters based on the average US home size and build. The Urban option will select the parameters based on the average U.S. office building. For the example of the Robin, an example shelter of a typical domestic Large Sport Utility Vehicle (SUV) is used.

Roof Material

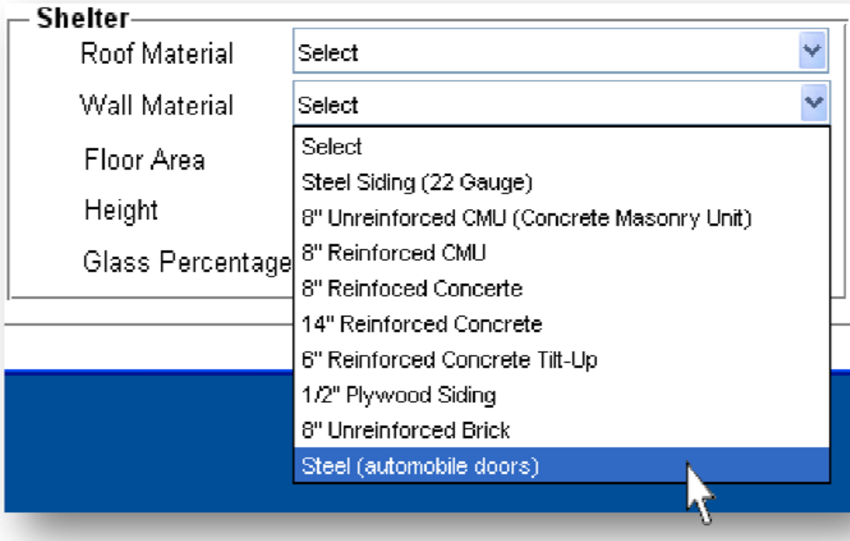
The Roof Material reflects the type of construction used for the roof of the shelter being investigated. Use the drop down menu and select the appropriate roof construction type.



For the SUV example, the roof material selection should be steel.

Wall Material

The Wall Material reflects the type of construction used for the wall of the shelter being investigated. Use the drop down menu to select the appropriate wall construction type.



For the SUV example, the wall material selection should also be steel.

Floor Area

The floor area of a structure is related to the overall building size. Enter the floor area of the desired shelter either by utilizing the scroll bar or by entering in the value directly.

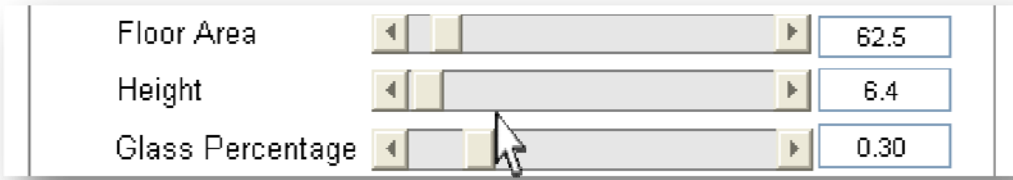
Height

The height of the anticipated shelter should be entered in feet using either the scrollbar or entering an exact value.

Glass Percentage

The glass percentage of the structure represents the proportion of the entire exterior of the building walls and roof constructed with transparent building materials. Glass has important aspects to personnel safety in that impacts with glass walls and windows on the exterior can cause the glass to fragment and result in many more piecing objects entering the building. Glass percentage should be added by either the scrollbar or entering in the value manually.
Note: Percentages should be entered in decimal form.

SUV Example input Continued



Floor Area	62.5 ft^2
Height	6.4 ft
Glass Percentage	30%

Preloaded Aircraft Parameters

The 3PRAT allows the user to select a predefined aircraft. The selected aircraft can then be used to auto populate the necessary inputs to generate an LCA. To select an aircraft, navigate to the [Preloaded Aircraft Types] Panel, click the drop down menu next to Aircraft 1, then select from the list of Aircraft Available.

OUTPUTS

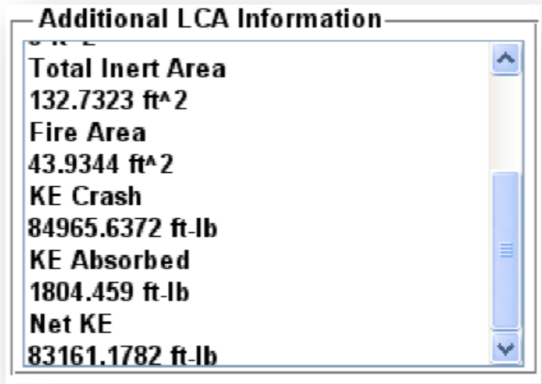
Lethal Crash Area

The LCA is the overall lethal area of the air vehicle in question. It accounts for different modes of lethality including direct impact, fragmentation, and secondary fires. There are combined as a union such that areas laid on top of one another are only counted once. The LCA in square feet is shown in bold.

The LCA for the given example of the Robin UAS is shown above as 132.718 ft^2.

Kinetic Energy Results

Kinetic Energy (KE) is a significant factor in determining the likelihood of lethality as well as the ability of a shelter to prevent injury from a collision. Because this accident characteristic is so important to the LCA results, it is shown after each iteration of the process.



The KE result for the Robin is shown above. The details regarding KE Crash, KE Absorbed, and Net KE are described below.

Kinetic Energy Crash

The KE of the crash indicates the total KE in ft-lb that the air vehicle would strike a target. Additionally, to the right of the KE is a logic tag indicating whether that amount of KE would be lethal.

Kinetic Energy Absorbed

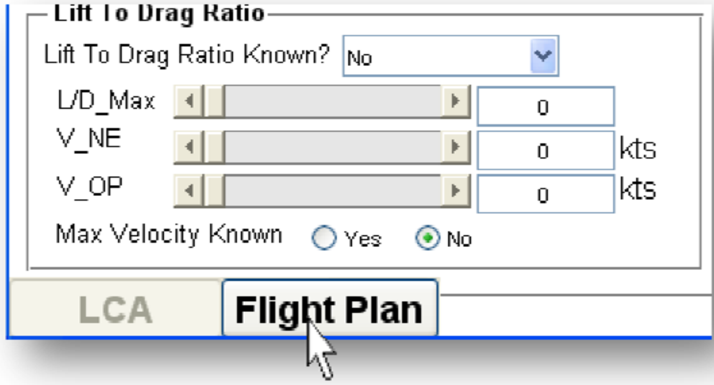
The KE Absorbed indicates the total KE that the shelter would absorb given the accident type, the building materials and the size of the aircraft. Accident type is important because it is assumed that for the departure case of accidents, that the air vehicle will make the initial impact with the shelter structure in a vertical attitude resulting in impact with the shelter roof. Therefore the rooftop material is what should be used. Conversely, a controlled landing assumes a gliding slope. In this case, the aircraft is assumed to glide in the hazard range of people, impact the ground, skid along the ground, and then slam into the building. This gives the most conservative result for total possible impact area.

Net Kinetic Energy

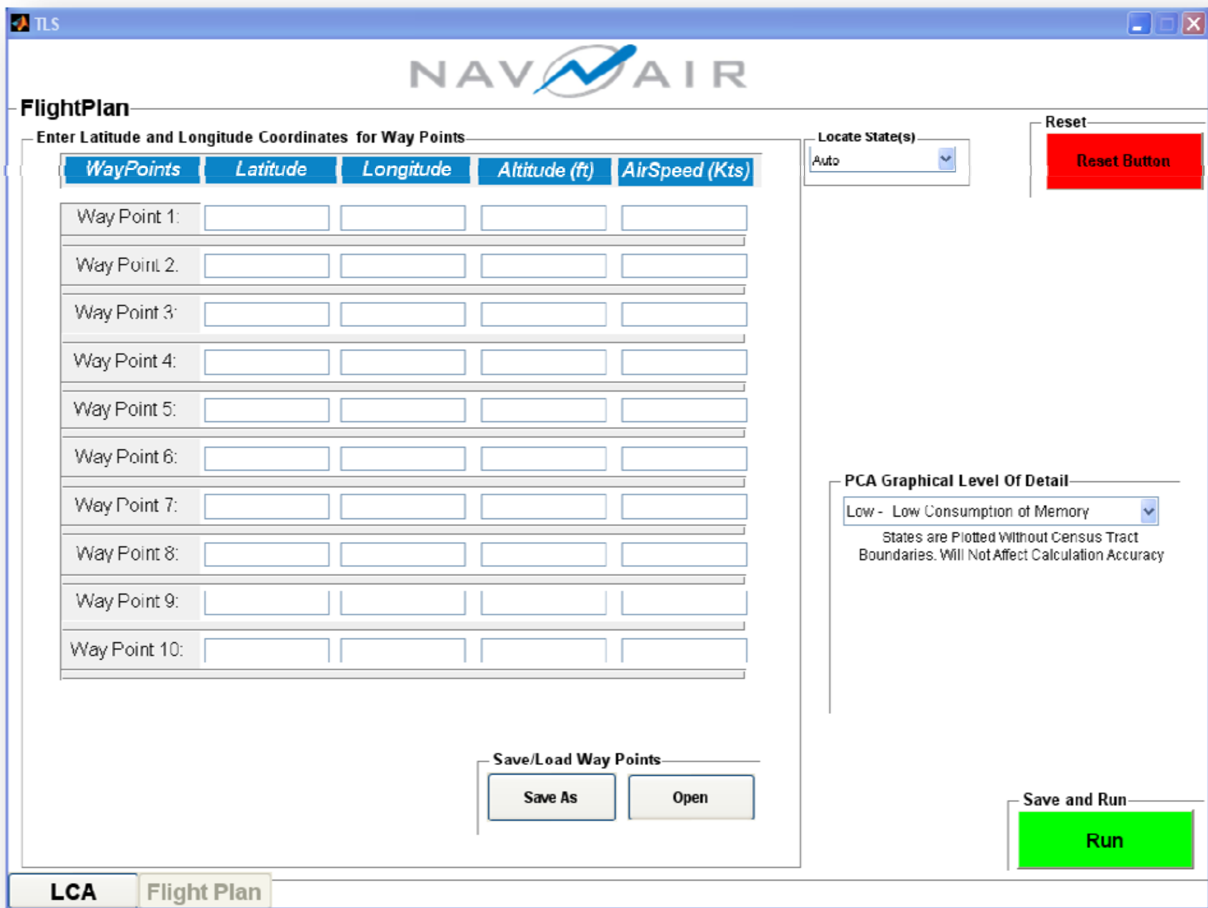
The Net KE is simply the difference between the amounts of KE available in the aircraft crash subtracted from the amount of KE absorbed by the shelter. As with the Crash KE, there is an additional logic tag to the right of the Net KE results to indicate whether the Net KE after shelter effects have been included would be lethal.

<u>FLIGHT PLAN TAB</u>

Flight Plan is the second page of the 3PRAT and can be accessed by clicking the Flight Plan tab located at the button left of the tool.



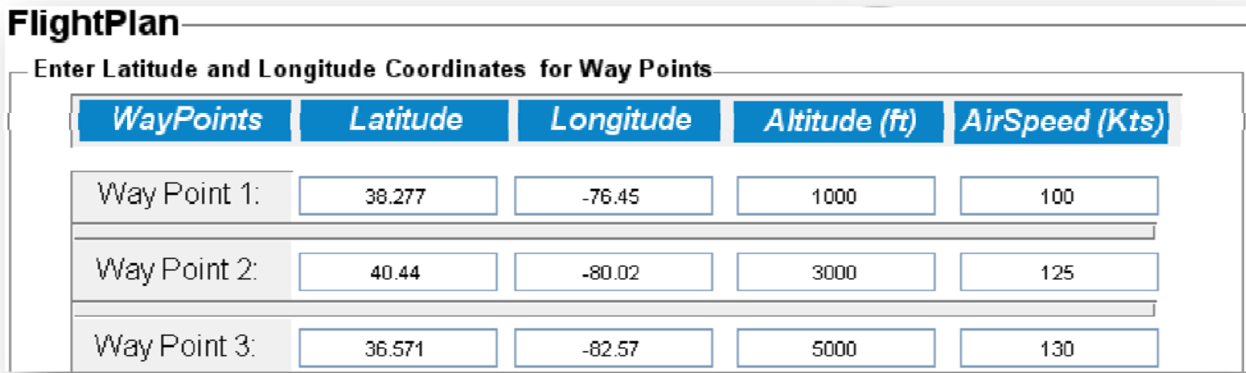
In the Flight Plan section, the user will be ask to enter waypoints information, this information is used to determine the flight path. Once the waypoint data are entered, the user will need to click on the RUN button; this will begin the calculation process.



INPUTS

Waypoints

Waypoints are used to determine flight path of the evaluated aircraft. Each waypoint should be entered in the corresponding waypoint number field. Each waypoint entry must contain Longitude, Latitude, Altitude, and Airspeed data. User must also enter a minimum of two way points to calculate risk along a flight path.



Latitude and longitude format should be entered as only degrees (real number), refer to table below for example.

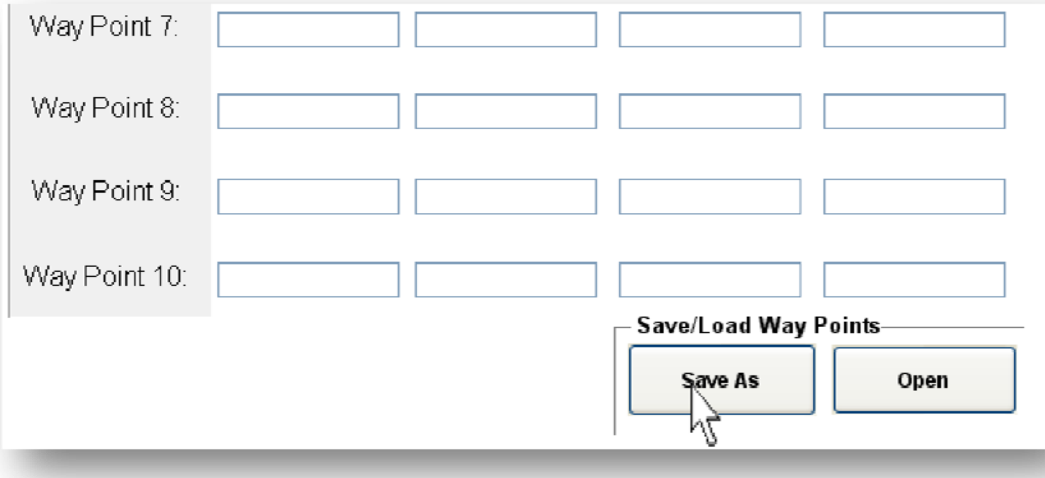
Table of Format

Coordinate Formats	Program Required Format
• 40:26:46N,79:56:55W • 40:26:46.302N 79:56:55.903W • 40°26′47″N 79°58′36″W • 40d 26′ 47″ N 79d 58′ 36″ W • 40.446195N 79.948862W • 40° 26.7717, -79° 56.93172	Latitude | Longitude 40.446195,-79.948862

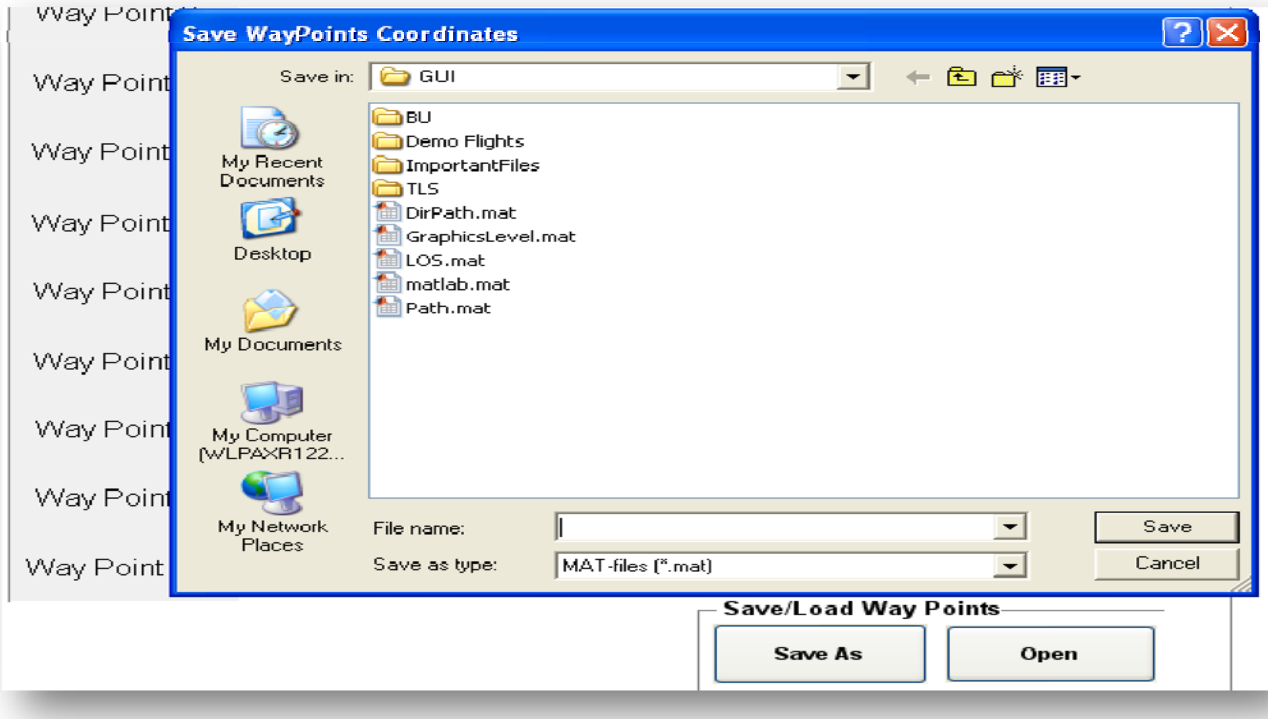
Altitude entry should be entered in feet and airspeed should be entered in knots.

Save/Load Waypoints

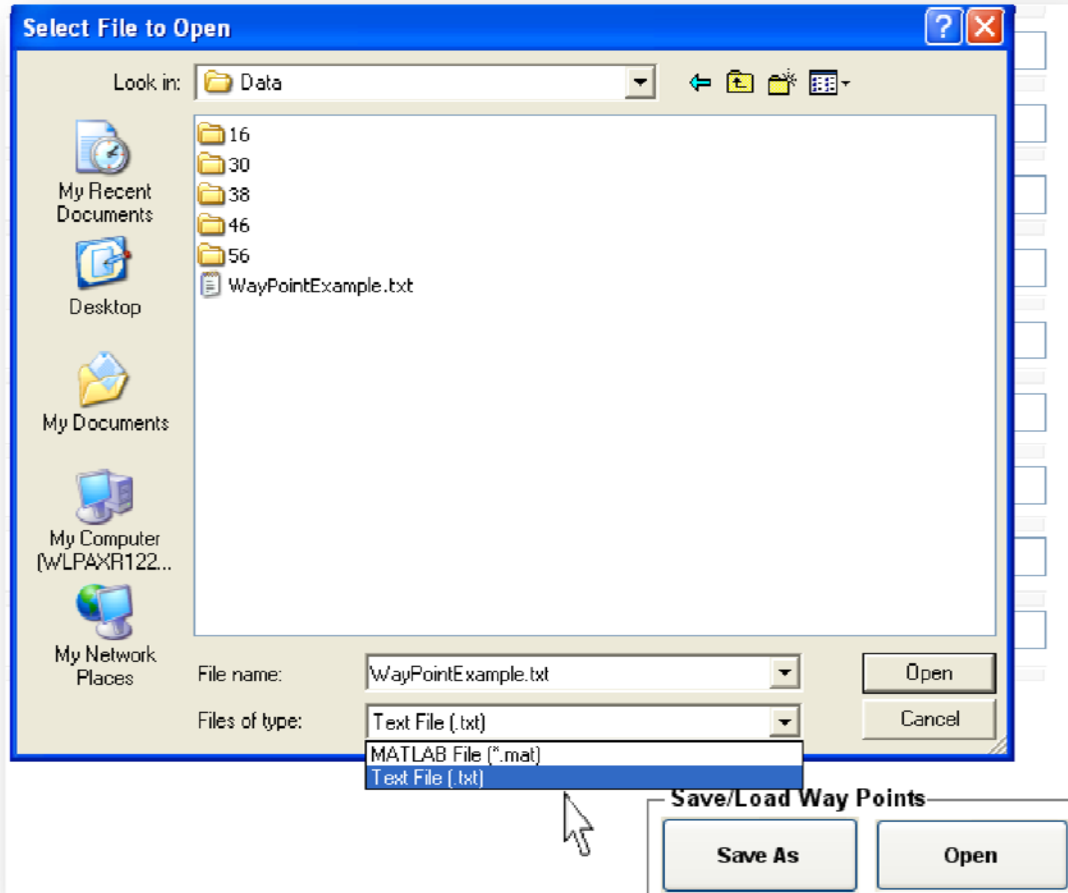
The TLS provides the user with the option to load or save waypoint entries. This task can be done by clicking on the save as or open buttons as seen below.



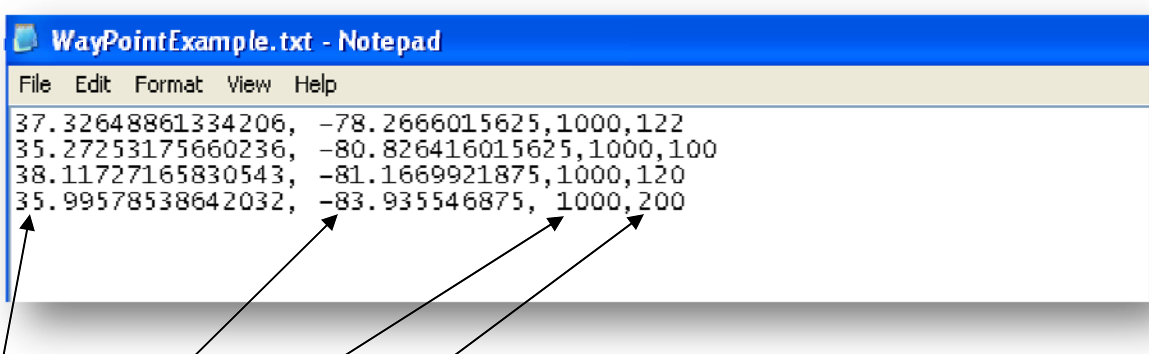
Once the save as or open button is clicked, a dialog box will appear giving the user the options to either save or open a flight path.



Waypoints can either be imported or exported with a .mat or .txt extension. To specify file extension, click open or save as on the 3PRAT, and click the drop down menu next to files of type as seen below.



Changing the Files of type selection to .txt or text file will display file types of .txt which can be imported as waypoints. Text files containing waypoint data should be formatted as displayed below:



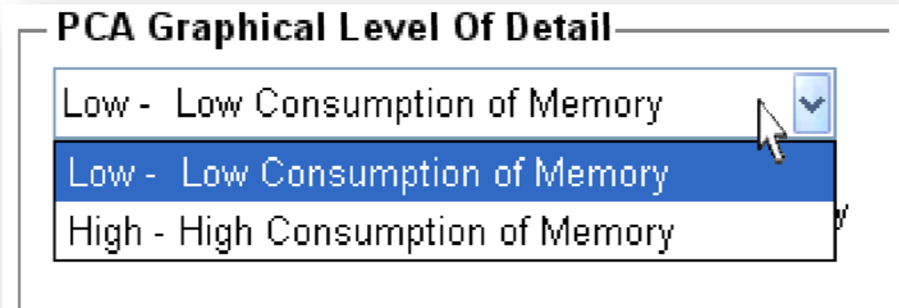
Latitude, Longitude, Altitude, Airspeed

The 3PRAT will only import the first 10 waypoint entries within the selected text file and will only carry up to 4 decimal places of each data point.

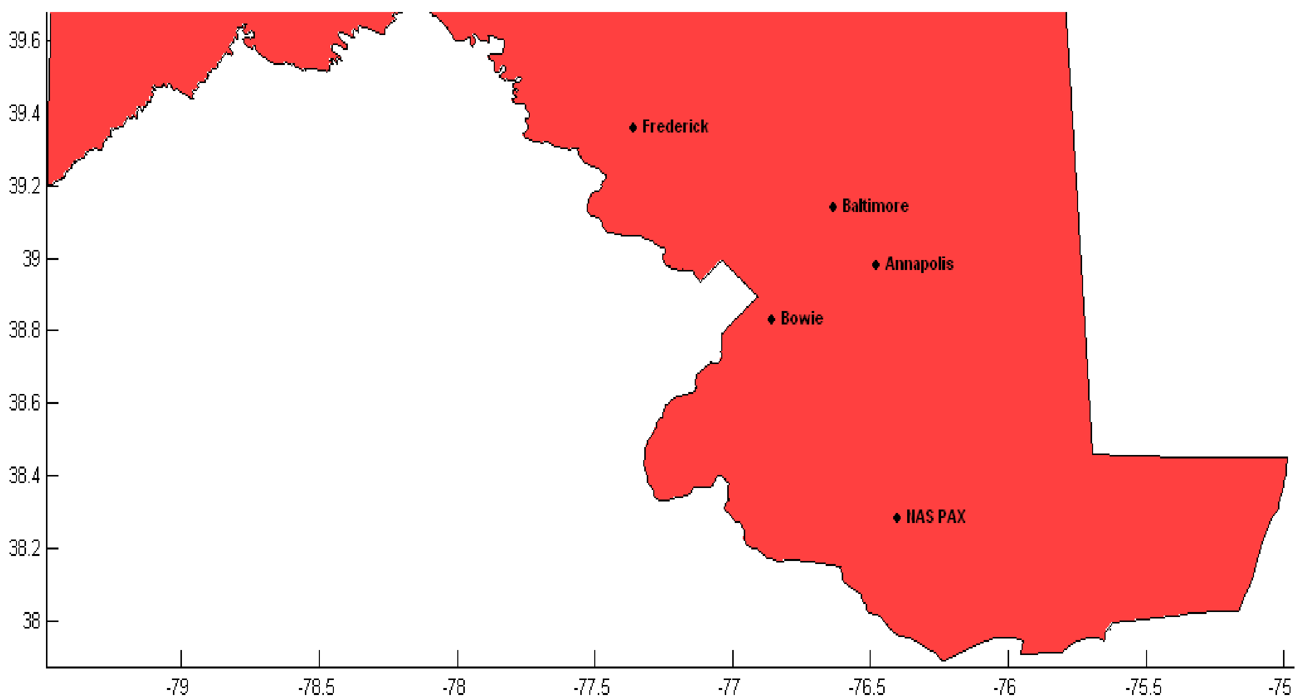
Note: To ensure waypoints are imported correctly, text file should only contain numbers corresponding to the four data entries required as displayed above.

Potential Crash Area Level of Detail

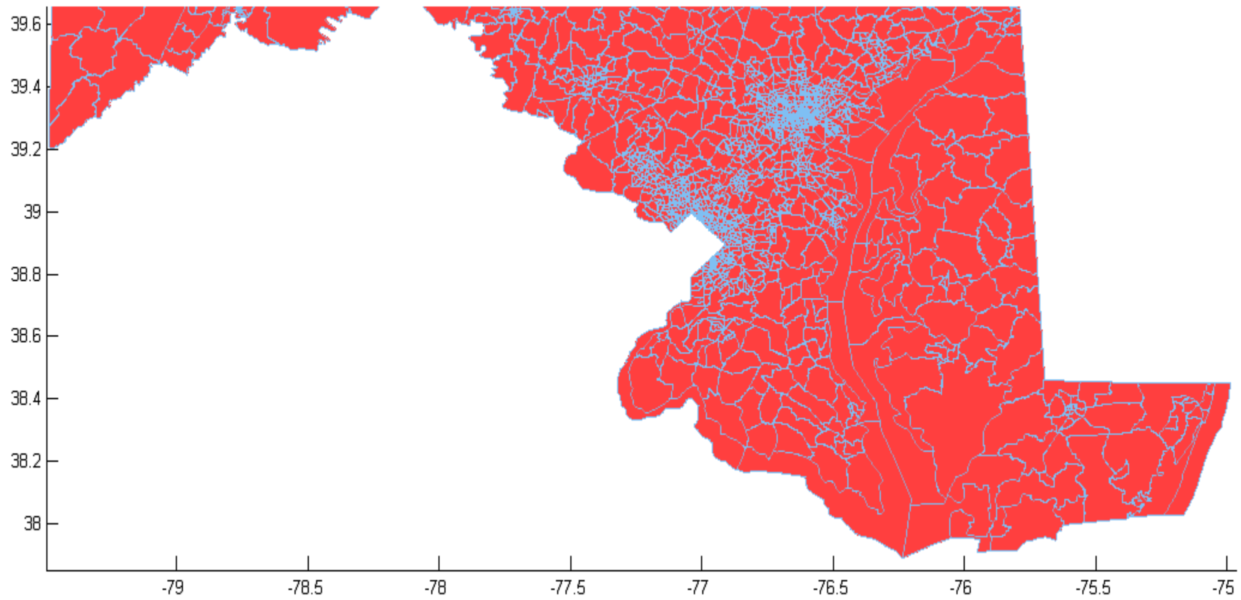
Potential Crash Area (PCA) level of detail allows the user the option of selecting the level of graphical detail of the states in which the PCA will be plotted over. Options are listed as Low or High. The program is defaulted to low which for most users will be ideal.



Selecting Low will generate an outline of the state in which the UAV flies over with no census tract separation; the state of Maryland is shown below.

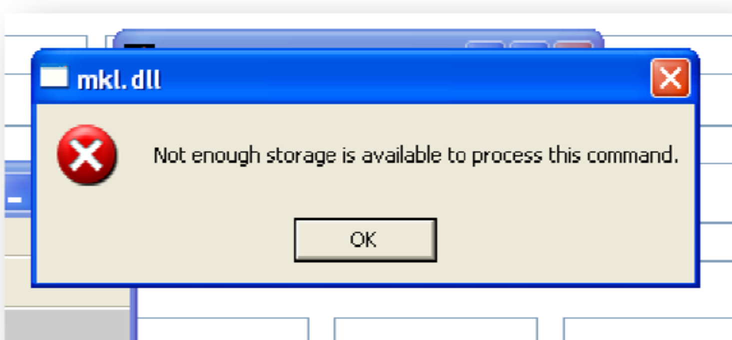


Selecting high will generate a much more detailed outline of the state in which the UAV flies over. As seen in the image below, the state of Maryland is again plotted; however, the state now contains individual census tract separations. This level of detail may be used to determine specifically which census area is affected by the PCA of the aircraft.



Warning
It is extremely important to note that selecting the high option to plot states requires large amounts of computer memory. Selecting low is strongly recommended if your computer is under powered or when flying over a large number of states.

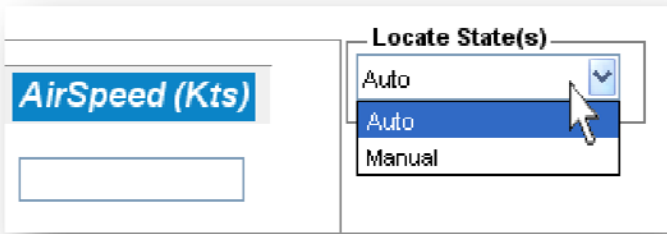
Once the amount of ram available to the 3PRAT is exhausted, the program will auto generate an error message, this error message is show below.



Note: Any and all memory error issues will require the user to close all windows associated with the program and re-launch the application.

<u>Auto/Manually Locate States</u>

The 3PRAT is defaulted to auto locate the states flown over based on way point data; however the tool allows the user the option to manually enter the states. To do this, the user would need to click on the drop down arrow next to the Locate Stat(s) option as seen below.



Once Manual is selected, a new panel will appear giving the user to options to enter up to 48 states. Listed on the right of this panel are the names of the states along with its associated code, users will need to enter the state code into the required field(s). Once completed, the user will need to click on the done button located below, this will close the panel.

Target Level of Safety Calculation and Plotting

Once all data are entered, the user can begin the calculation by clicking on the RUN button located on the button right of the Flight Plan page.

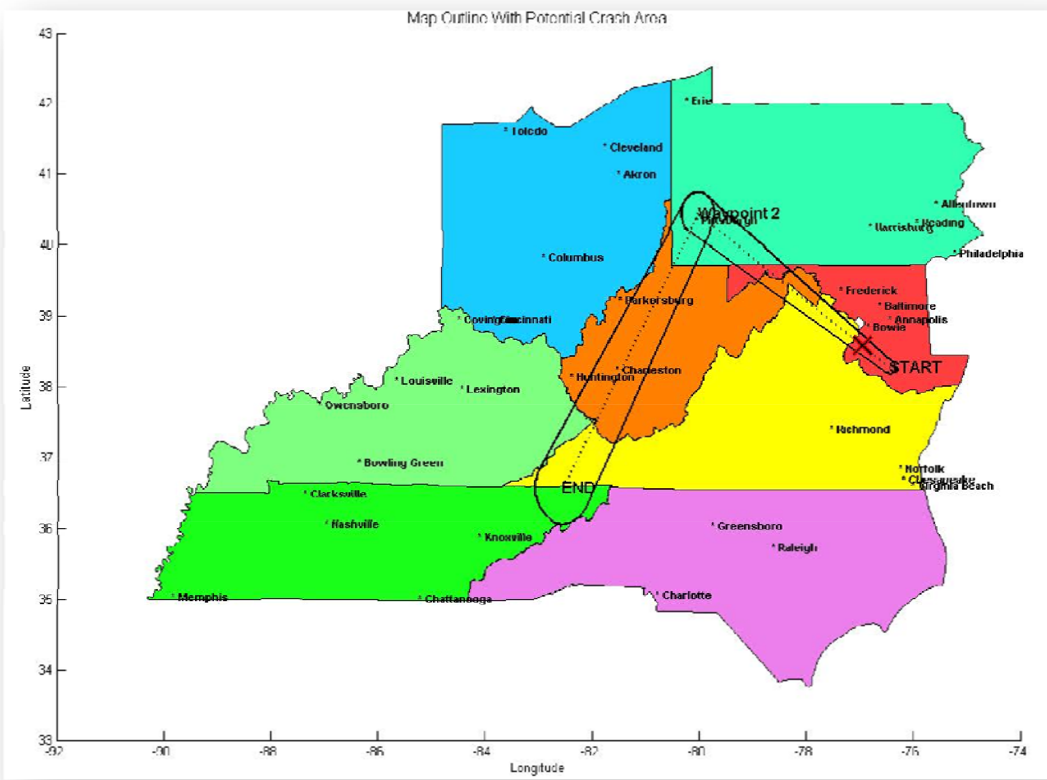
Warning
It is extremely important to note that users should not change the active windows of the program while calculations are in progress. If the active window were to be changed to either the main page or loading progress bar during loading of states, creation of PCA or calculation of census tracts, the remaining plotting process will become distorted.

Note: Plots are for visual reference only; distorted plots will have no affect on the final calculations displayed on the GUI's Flight Summary.

OUTPUTS

Map of Potential Crash Area

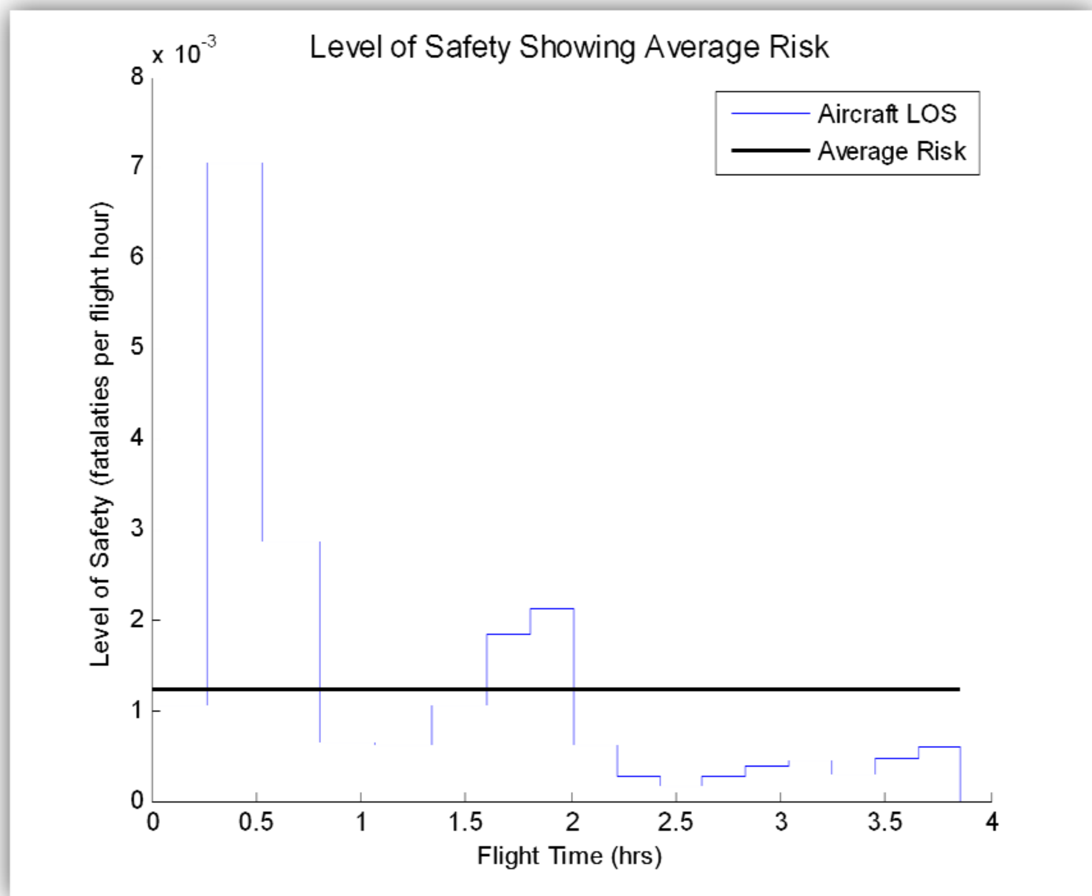
After all calculations are completed, the 3PRAT will generate a map containing the state(s) in which your flight occurs.



The map is overlaid with the aircraft's PCA which stretches along the flight path. The PCA path is labeled for clarity with the direction of flight and the waypoint number. The map will also contain a red X, this point represents where the lowest level of safety (LOS), or highest flight risk occurred. *(Note: PCA paths are discretize at varying levels so that peaks of LOS are correctly captured. The red X is plotted at the beginning of a discreted portion of the PCA and not the exact location of lowest LOS peak*)

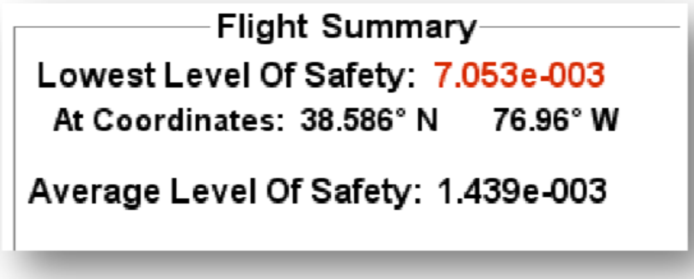
Risk Chart

The 3PRAT also generates a risk chart; this chart displays the associated risk along the flight path. This chart is plotted as LOS versus flight time, and also displays the average risk for the entire flight.



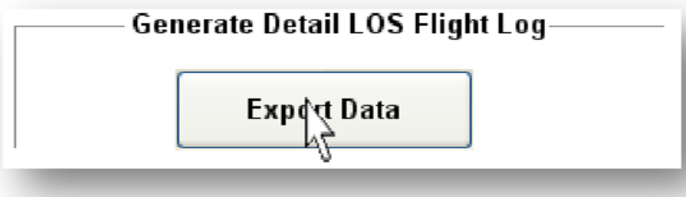
Graphical User Interface Results Panel

The 3PRAT will display a summary of the risk associated with the last flight path that was ran. The summary, displayed below includes lowest LOS value, the latitude and longitude in which it occurred, along with the flights average LOS.

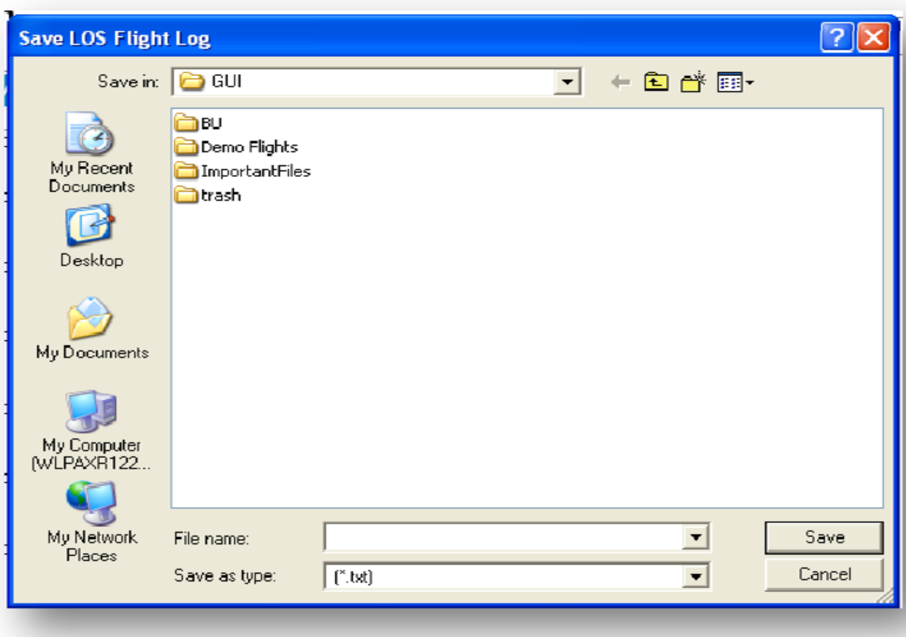


Export Detail Level of Safety Flight Log

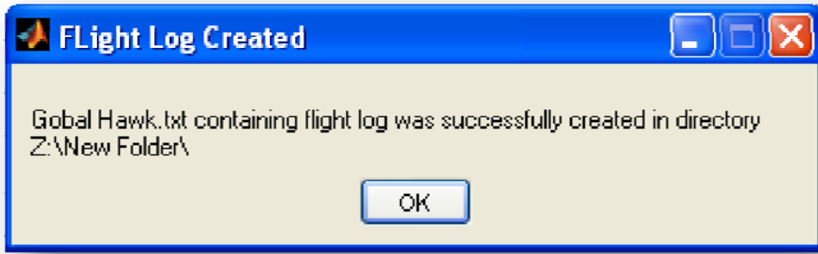
The 3PRAT provides users with the option to export a more detail log of the flight path as a text file. To export the data, click on the export data button as seen below.



Once the export data button is clicked, a dialog box will appear giving the user the option to save the flight log.



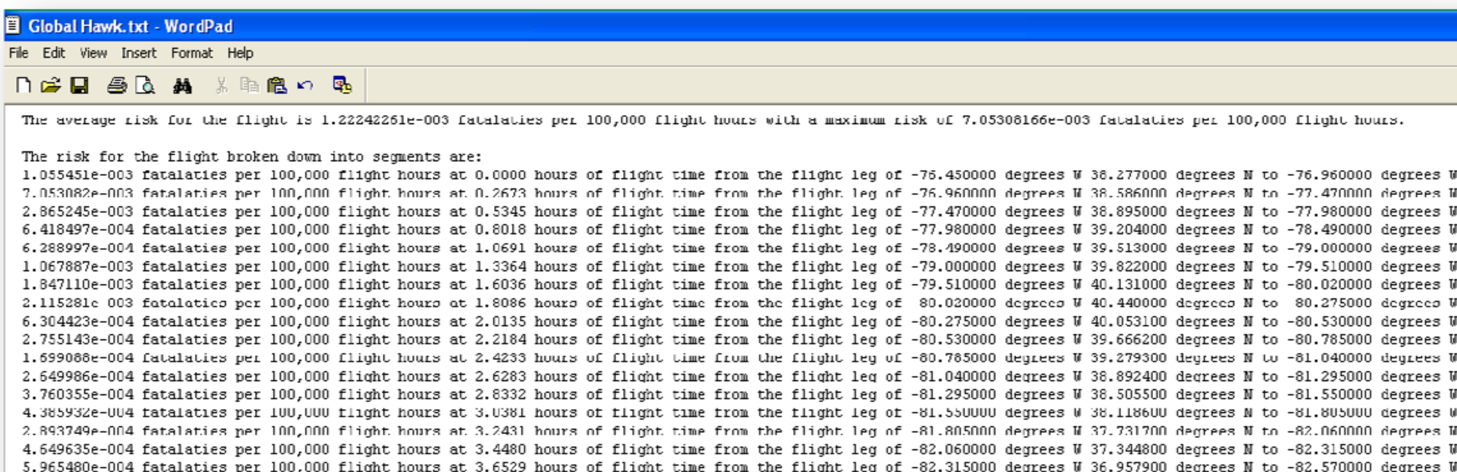
After hitting the save button, the 3PRAT will then generate a dialog box as displayed below containing information on the name of the file as well as the directory in which it was saved.



Accessing Exported Text File

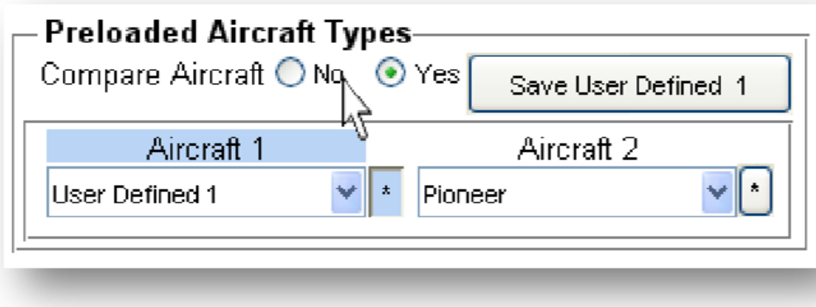
The exported text file is best viewed in WordPad. WordPad is typically located in Start ->All Programs ->Accessories->WordPad. In WordPad click on file, open. User should then navigate to the directory in which the file was saved, clicking the down arrow next to Files of type:, select all files, this will display all file association.

As displayed below, the exported file will contain average risk, maximum risk and individual risk associated along flight path.



Comparing Level of Safety

The 3PRAT allows for aircraft comparison of LOS. To perform an aircraft LOS comparison, on the LCA tab, navigate to the [Preloaded Aircraft Types] panel then click Yes on the Compare Aircraft radio button as seen below.



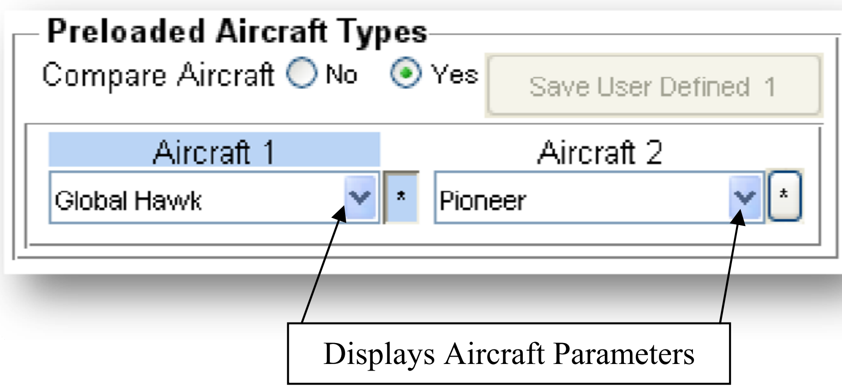
Clicking yes on the radio button will enable the option to select a second aircraft in which LCA and ultimately LOS can be calculated and compared.

INPUTS

In aircraft comparison mode, the user is allowed to compare any two aircraft including up to two custom aircraft using the same flight route.

Comparing Predefined Aircraft

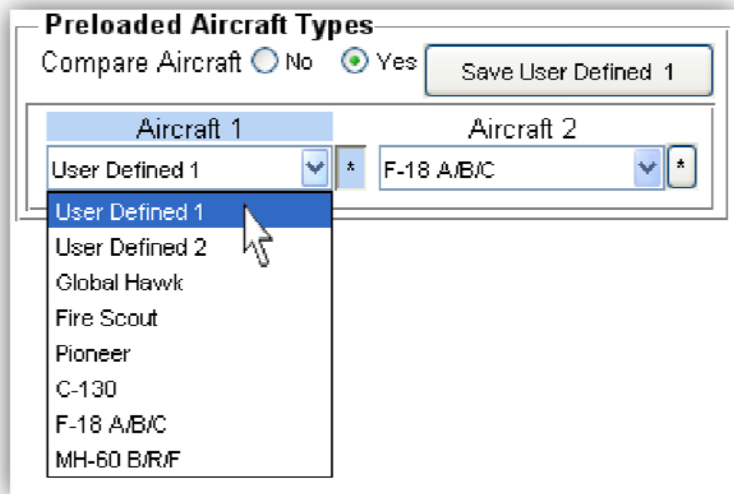
To compare two predefined aircraft, select an aircraft as Aircraft 1 and another as Aircraft 2 from the appropriate drop down menu as seen below.



To show Aircraft 1 or 2 parameters, click on the toggle button located next to the drop down menu of the aircraft in which you wish to view. Once the specific toggle button is clicked, the aircraft title will change colors indicating which aircraft parameters are currently being displayed.

Comparing User-Defined Aircraft

To compare one user-defined aircraft to a predefined aircraft, select User Defined 1 or User Defined 2 as Aircraft 1, then select a predefined aircraft as Aircraft 2 from the appropriate drop down menu as seen below.



Once selected, ensure that the show aircraft toggle button is displaying the user defined aircraft. The Save User Defined # button will display the option to save the manually entered parameters as the specific user defined number aircraft. After entering in all aircraft parameters as described in the section above, click the Save User Defined # button, and then click on the Generate LCA Button.

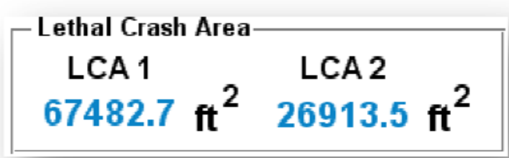
To compare two user-defined aircrafts, repeat the above steps using User Defined 1 as Aircraft 1, next click the toggle button to show Aircraft 2, and then select User Defined 2 as Aircraft 2 repeating the above steps to save manually entered aircraft parameters as User Defined 2.

OUTPUTS

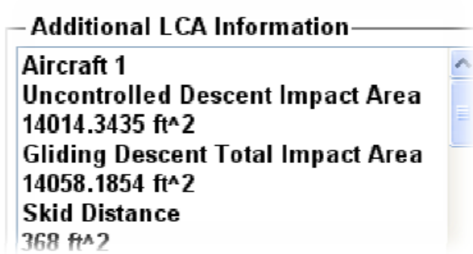
In aircraft comparison mode, the 3PRAT will now generate two LCAs and two KEs results as seen below.

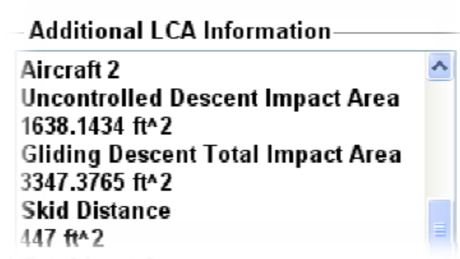
Lethal Crash Area

The LCA results will now be displayed as a pair, with LCA 1 corresponding to Aircraft 1 and LCA 2 to Aircraft 2.



Kinetic Energy Results

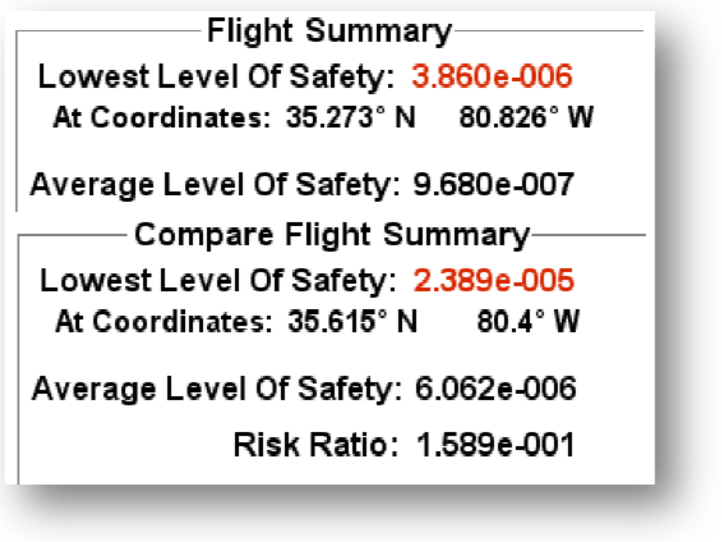




The KE results for both aircraft are displayed within the same text box, Aircraft 2 results can be accessed by using the scroll bar.

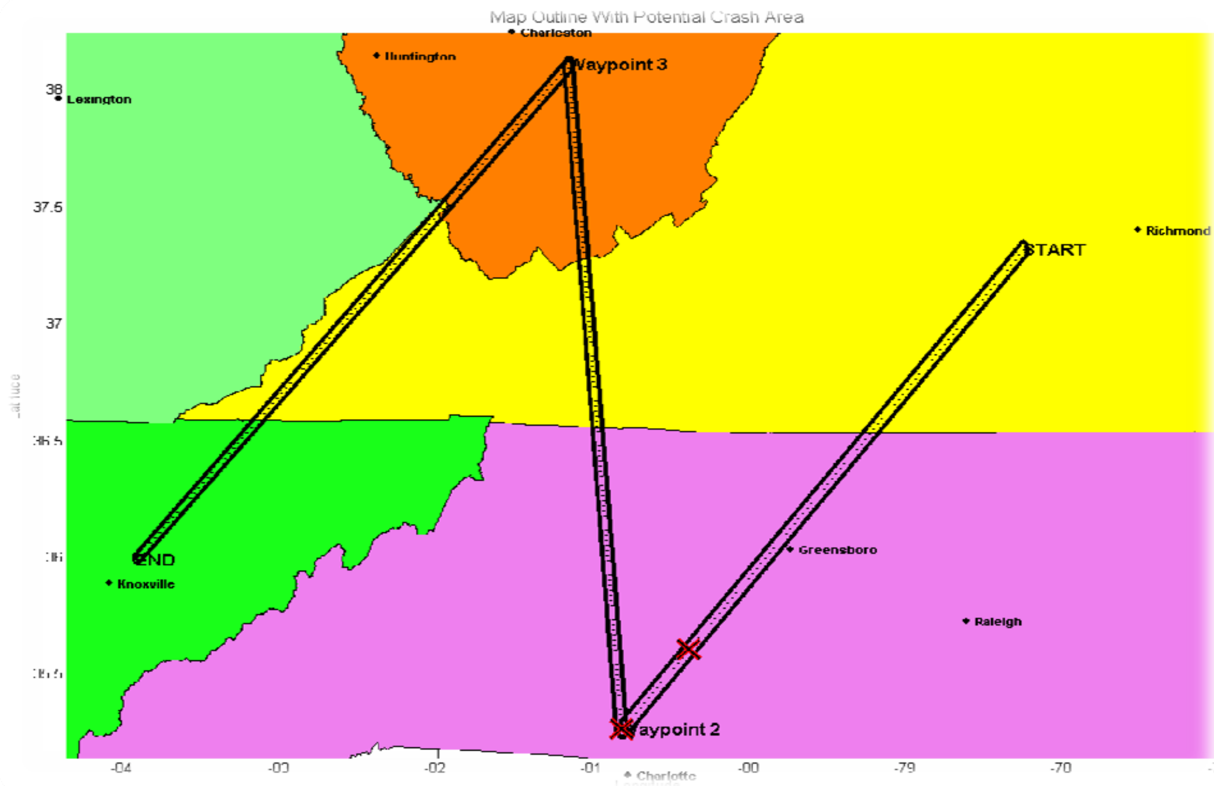
Graphical User Interface Results Panel

The 3PRAT will now display two summaries of the risk associated with the last flight path. The summary represents the comparison for both aircraft along with the average Risk Ratio between them during the flight.

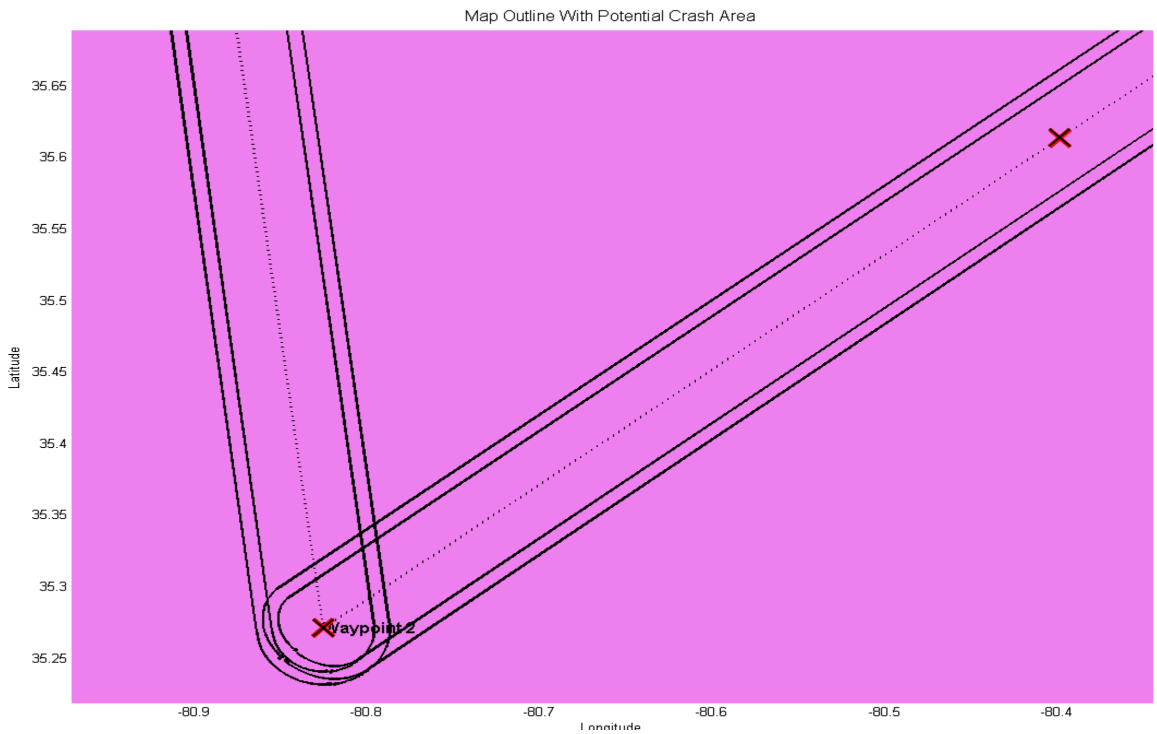


Map of Potential Crash Area

After all calculations are completed, the 3PRAT will generate a map of your PCA.

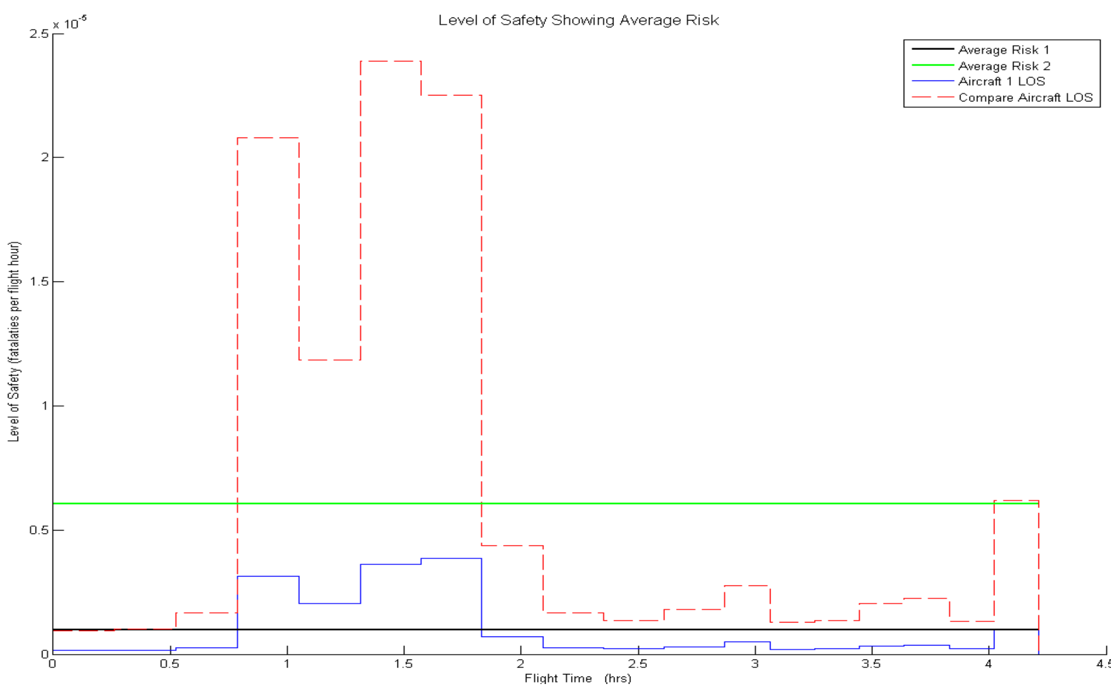


In aircraft comparison mode, because two aircrafts are being compared, you will notice that there may be two PCAs and two possible points at which the LOS can be peaked. (*Note for helicopter comparisons, the model for PCA is that of a ballistic projectile, therefore the PCAs will be dictated by the flight path input resulting in the same PCA*)



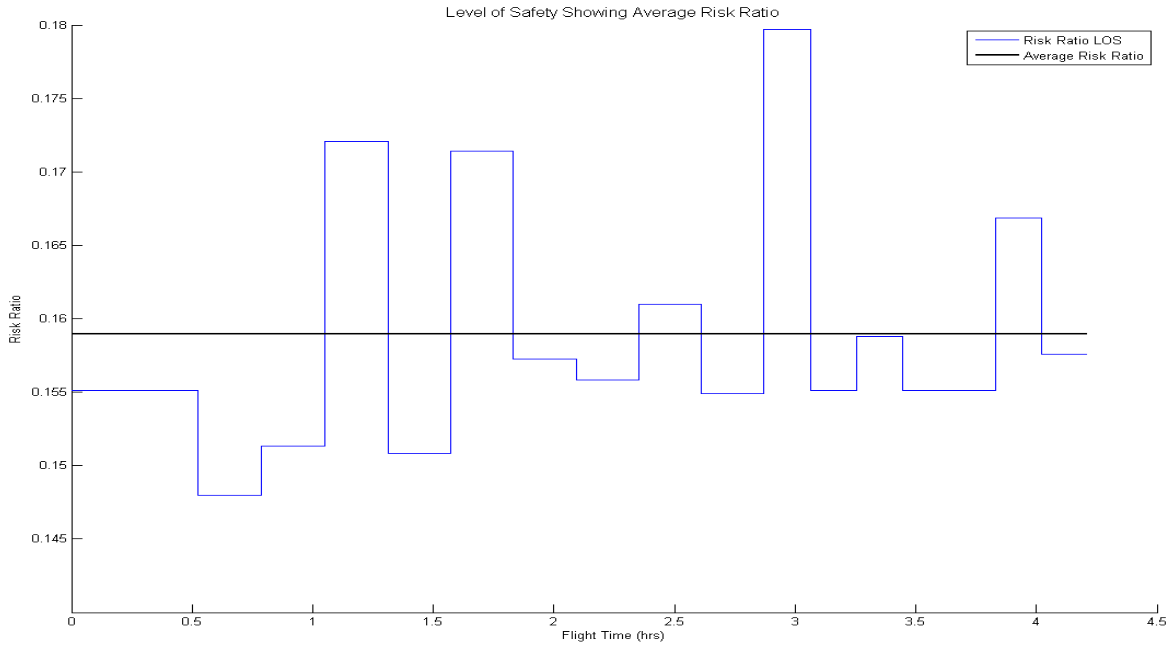
Risk Chart

In comparison mode, the Risk Plot will now generate a LOS plot for both Aircraft 1 and Aircraft 2, along with their associated average as seen below.



Risk Ratio

In compare mode, the 3PRAT will now generate a Risk Ratio chart. This chart shows the comparative risk between the two aircraft, along with an overall risk average for the flight.



Note: For helicopter comparisons, since the PCAs do not differ, LOS used for comparison calculation will differ only by PLOA and LCA both of which are static inputs. This results in a constant risk ratio throughout the flight.

KNOWN TROUBLESHOOTING ISSUES

THIS PAGE INTENTIONALLY LEFT BLANK

GLOSSARY

Lethal Crash Area (LCA)	The total area in which lethality could occur as the result of a UAS crash.
Loss of Control (LOC)	Point at which the aircraft has lost the ability to maintain course or recover from significant input typically resulting in violent attitude changes and uncontrolled termination of flight.
Operating Velocity (V_{op})	The design velocity that aircraft will maintain during normal operations. For surveillance aircraft, operating velocity should be similar to the maximum endurance velocity. For transport aircraft, the maximum range velocity would be used.
Height (H)	Height AGL that an aircraft encounters a termination of flight event.
Lift-to-Drag (L/D) Ratio	A measure of the aircraft design with respect to several aerodynamic features. In general, a higher L/D will result in better fuel economy, climb performance, and glide path angle.
Glide Path Angle (γ)	The glide path angle represents the ratio of forward distance traveled to the decrease in altitude of an air vehicle. A higher glide path angle typically results in a steep faster impact with the ground resulting in more energy and internal loads being transferred over a short period of time than a shallow descent. For crash area estimates, a shallower angle results in less kinetic energy, but a greater total area of possible impact than a steep angle.
Probability of Loss of Aircraft (PLoA)	Probability that a particular aircraft would experience a mishap, either derived from a reliability block diagram or from historical data based on 100,000 flight-hours.
Level of Safety (LOS)	Fatalities expected per 100,000 flight-hours characterized by the following equation: LOS= PLoA * POCA (LCA * Population density).

Share Drive Folder :

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX
EXAMPLE UAS SPECIFICATIONS

ROBIN

Characteristic	Value	Units
Aircraft Type	Airplane	N/A
Airplane Type	General Aviation	N/A
Engine Type	Piston	N/A
Number of Engines	1	N/A
Gross Weight	200	lb
Wingspan	12	ft
Length	9	ft
Fuselage Width	0.7	ft
Fuselage Height	0.7	ft
Fuel Weight	75	lb
Fuel Type	AvGas	N/A
L/D_{max}	Unknown	N/A
Max Velocity	Unknown	kt
Operating Velocity	70	kt

LARGE DOMESTIC SUV SHELTER PARAMETERS

Characteristic	Value	Units
Roof Material	Steel (automobile)	N/A
Wall Material	Steel (automobile doors)	N/A
Floor Area	62.5	ft^2
Height	6.4	ft
Glass Percentage	30	%

THIS PAGE INTENTIONALLY LEFT BLANK

DISTRIBUTION:

NAVAIRSYSCOM (AIR-4.3.1 - Cochran), Bldg. 2187, Room 3358 48110 Shaw Road, Patuxent River, MD 20670-1906	(4)
NAVAIRSYSCOM (AIR-4.5 - Burke), Bldg. 2272, Room 253 47123 Buse Road, Patuxent River, MD 20670-1547	(5)
NAVAIRSYSCOM (AIR-4.6.2 - Knott), Bldg. 2187, Room 1280D5 48110 Shaw Road, Patuxent River, MD 20670-1906	(2)
NAVAIRSYSCOM (AIR-4.5.1 - Andrew), Bldg. 2187, Room 2242 48110 Shaw Road, Patuxent River, MD 20670-1906	(2)
NAVAIRWARCENACDIV (5.1.2.1 - Ball), Bldg. 111, Room 240 22755 Saufley Road, Patuxent River, MD 20670-1619	(2)
U.S. Army Research Laboratory (N. Bradley), Vehicle Technology Directorate 4603 Flare Loop, Aberdeen Proving Grounds, MD 21005	(1)
NAVAIRWARCENACDIV (4.3.2.6 - Donley), Bldg. 2187, Room 1313 48110 Shaw Road, Patuxent River, MD 20670-1906	(1)
NAVAIRSYSCOM (AIR-4.10 - Polakovics), Bldg. 2187, 48110 Shaw Road, Patuxent River, MD 20670-1906	(1)
NAVAIRWARCENACDIV (5.2.2G - Jacob), Bldg. 2118, Room 110 23013 Cedar Point Road, Patuxent River, MD 20670	(1)
NAVAIRSYSCOM (AIR-5.1G - Roberts), Bldg. 8010 47320 Priests Point Loop, St. Inigoes, MD 20684-4017	(1)
NAVAIRSYSCOM (UASTD - Heasley), Bldg. 8127 17637 Nesea Way, St. Inigoes, MD 20684-4015	(1)
NAVAIRSYSCOM (PEO U&W - Daniels), Bldg. 2272, Room 253 47123 Buse Road, Patuxent River, MD 20670-1547	(1)
NAVAIRSYSCOM (PEO U&W - Evans), Bldg. 2272, Room 246 47123 Buse Road, Patuxent River, MD 20670-1547	(1)
NAVAIRSYSCOM (AIR-4.1.6 - Zidzick), 235, Bldg. 4010, Room 235 48187 Standley Road, Patuxent River, MD 20670	(1)
NAVAIRSYSCOM (AIR-4.3D - Rubinsky), Bldg. 2187, Room 3322 48110 Shaw Road, Patuxent River, MD 20670-1906	(1)
NAVAIRSYSCOM (AIR-4.5.1 - Thorpe), Bldg. 2187, Room 2242 48110 Shaw Road, Patuxent River, MD 20670-1906	(1)
ARMY (RDMR-AEV - Flynn), 4488 Martin Road Redstone Arsenal, AL 35898	(1)
NAVAIRWARCENACDIV (AIR-4.0P - Adams), Bldg. 460, Room 222 22244 Cedar Point Road, Patuxent River, MD 20670-1163	(1)
NAVAIRWARCENACDIV (AIR-5.0E - Rusher), Bldg. 1492, Room 24 47758 Ranch Road, Patuxent River, MD 20670-1456	(1)
WPAFB (ESC/ENSI - Rodreguez), Bldg. 28 Wright Patterson AFB, OH 45433	(1)
WPAFB (ABSSA/SIPT - Schaeffer), Area B, Bldg. 557, Room 005D Wright Patterson AFB, OH 45433	(1)

Pentagon (OUSD [AT&L]/S&TS-Unmanned Warfare - Greenly), Room 3B938 3090 Defense Pentagon, Washington, DC 20301-3090	(1)
NAVAIRWARCENACDIV (4.12.6.2), Bldg. 407, Room 116 22269 Cedar Point Road, Patuxent River, MD 20670-1120	(1)
DTIC 8725 John J. Kingman Road, Suite 0944, Ft. Belvoir, VA 22060-6218	(1)

NAVAL AIR WARFARE CENTER AIRCRAFT DIVISION
PATUXENT RIVER, MARYLAND

ERRATA

ERRATA NUMBER: NAWCADPAX/RTR-2012/219E

DATE: 2 July 2013

FROM:
Commander, Naval Air Warfare Center Aircraft Division, Patuxent River, Maryland 20670-1161

TO:
Commander, Naval Air Systems Command Headquarters, 47123 Buse Road, Patuxent River, Maryland 20670-1547

REPORT NO.:	**DATE:**
NAWCADPAX/RTR-2012/219	26 June 2012

REPORT TITLE:
Third Party Risk Assessment Tool (3PRAT) User Guide

REQUEST THAT RECIPIENTS OF THE ABOVE REPORT INCORPORATE THE FOLLOWING CORRECTIONS:

Per Public Release Authorization Request No. 2013-591, make pen and ink change to Distribution statement to read: Approved for public release; distribution is unlimited.

B385849

20121017224

DISTRIBUTION:	**RELEASED BY:**
Same as original document.	27 Jun 2013 ROLAND COCHRAN / 4.3.1 / DATE Air Vehicle Systems Engineering Division Naval Air Warfare Center Aircraft Division